2020 Simulation and Animation Design

Program CIP: 50.0411 - Game and Interactive Media Design

Direct inquiries to:

Instructional Design Specialist
Research and Curriculum Unit
P.O. Drawer DX
Mississippi State, MS 39762
662.325.2510

Program Coordinator
Office of Career and Technical Education
Mississippi Department of Education
P.O. Box 771
Jackson, MS 39205
601.359.3974

Published by:

Office of Career and Technical Education
Mississippi Department of Education
Jackson, MS 39205

Research and Curriculum Unit
Mississippi State University
Mississippi State, MS 39762

The Research and Curriculum Unit (RCU), located in Starkville, as part of Mississippi State University (MSU), was established to foster educational enhancements and innovations. In keeping with the land-grant mission of MSU, the RCU is dedicated to improving the quality of life for Mississippians. The RCU enhances intellectual and professional development of Mississippi students and educators while applying knowledge and educational research to the lives of the people of the state. The RCU works within the contexts of curriculum development and revision, research, assessment, professional development, and industrial training.

Table of Contents

Acknowledgments

The simulation and animation design (SAD) curriculum was presented to the Mississippi State Board of Education on January 16, 2020. The following persons served on the state board at the time:

Dr. Carey M. Wright, state superintendent of education
Dr. Jason S. Dean, chair
Mr. Buddy Bailey, vice chair
Ms. Rosemary G. Aultman
Dr. Karen Elam
Dr. John R. Kelly
Ms. Nancy Collins
Ms. Brittany Rye
Mr. Sean Suggs
Mr. Omar G. Jamil
Ms. Shelby Dean

The following Mississippi Department of Education (MDE) and RCU managers and specialists assisted in the development of the curriculum:

Wendy Clemons, associate superintendent of education for the Office of Career and Technical Education (CTE) at the MDE, supported the RCU and the teachers throughout the development of the SAD curriculum framework and supporting materials.

Dr. Aimee Brown, bureau director for the Office of Career and Technical Education, supported the developmental and implementation process of the curriculum framework and supporting materials.

Sandra Gibson, instructional design specialist for the RCU at MSU, researched and co-authored this framework. sandra.gibson@rcu.msstate.edu

Kenny Langley, instructional design specialist for the RCU at MSU, researched and co-authored this framework. kenny.langley@rcu.msstate.edu

Also, special thanks are extended to the teachers who contributed teaching and assessment materials that are included in the framework and supporting materials:

Ken Boyte, Hinds Pearl-Rankin, Raymond
Regina Covington, College and Career Technical Institute, Pascagoula
Marcus Johnson, Carl Keen CTE Center, Clarksdale
Robert Lord, Hinds Vicksburg-Warren, Vicksburg
Tiffany Turnage, Madison Career and Technical, Madison
Myesha Wallace, Jackson Public Schools Career Development Center, Jackson
Monica Washington, Hinds Pearl-Rankin, Raymond

~~Appreciation is expressed to the following professionals who provided guidance and insight throughout the development process:~~

~~Shanta Villanueva, TSA and STEM program coordinator for the MDE Office of CTE and Workforce Development~~
~~Betsey Smith, director for the RCU at MSU~~
~~Brad Skelton, curriculum manager for the RCU at MSU~~
~~Melissa Luckett, instructional design specialist for the RCU at MSU~~

Standards

Standards and alignment crosswalks are referenced in the appendices. Mississippi's CTE SAD curriculum is aligned to the following standards:

Common Career Technical Core Standards for the Arts, Audio-Video Technology, and Communications Career Cluster

The Common Career Technical Core (CCTC) is a state-led initiative coordinated by the National Association of State Directors of Career Technical Education/National career Technology Education Foundation (NASDCTEc/NCTEF) to establish a set of rigorous, high-quality standards for CTE that states can adopt. A diverse group of teachers, business and industry experts, administrators, and researchers helped guide the development of the CCTC from beginning to end to ensure CTE students will have the knowledge and skills to thrive in a global economy. The SAD curriculum will be aligned to the CCTC Standards for the Arts, Audio-Video Technology, and Communications Cluster. Copyright 2012. NASDCTEc/NCTEF. All rights reserved. Retrieved from careertech.org/CCTC.

College- and Career-Ready Standards

College- and career-readiness standards emphasize critical thinking, teamwork, and problem-solving skills. Students will learn the skills and abilities demanded by the workforce of today and the future. Mississippi adopted *Mississippi College and Career Ready Standards* (*MCCRS*) to provide a consistent, clear understanding of what students are expected to learn and so teachers and parents know what they need to do to help them.
mdek12.org/OAE/college-and-career-readiness-standards

International Society for Technology in Education (ISTE) Standards

Reprinted with permission from *ISTE Standards for Students*, © 2016, International Society for Technology in Education, 800-336-5191 (US and Canada) or 541-302-3777 (International), iste@iste.org. All rights reserved. Permission does not constitute an endorsement by ISTE.
iste.org

Framework for 21st Century Learning

In defining 21st century learning, the Partnership for 21st Century Skills has embraced key themes and skill areas that represent the essential knowledge for the 21st century: global awareness; financial, economic, business, and entrepreneurial literacy; civic literacy; health literacy; environmental literacy; learning and innovation skills; information, media, and technology skills; and life and career skills. *21 Framework Definitions*. Published 2015.
p21.org/storage/documents/docs/P21_Framework_Definitions_New_Logo_2015.pdf

Preface

Secondary CTE programs in Mississippi face many challenges resulting from sweeping educational reforms at the national and state levels. Schools and teachers are increasingly being held accountable for providing applied learning activities to every student in the classroom. This accountability is measured through increased requirements for mastery and attainment of competency as documented through both formative and summative assessments. This document provides information, tools, and solutions that will aid students, teachers, and schools in creating and implementing applied, interactive, and innovative lessons. Through best practices, alignment with national standards and certifications, community partnerships, and a hands-on, student-centered concept, educators will be able to truly engage students in meaningful and collaborative learning opportunities.

The courses in this document reflect the statutory requirements as found in Section 37-3-49, *Mississippi Code of 1972*, as amended (Section 37-3-46). In addition, this curriculum reflects guidelines imposed by federal and state mandates (Laws, 1988, Ch. 487, §14; Laws, 1991, Ch. 423, §1; Laws, 1992, Ch. 519, §4 eff. from and after July 1, 1992; Carl D. Perkins Vocational Education Act IV, 2007; and Every Student Succeeds Act, 2015).

Mississippi Teacher Professional Resources

The following are resources for Mississippi teachers:

Curriculum, Assessment, Professional Learning

Program resources can be found at the RCU's website, rcu.msstate.edu.

Learning management system: An Online Resource

Learning management system information can be found at the RCU's website, under Professional Learning.

Should you need additional instructions, call 662-325-2510.

Executive Summary

Pathway Description

SAD is a pathway in the arts, audio-video technology, and communications career cluster. This program is designed for students who wish to develop, design, and implement projects in the ever-expanding field of game design and development. The program emphasizes the techniques and tools used in game design and the creative design of content of such media. Both theoretical learning and activity-based learning are provided for students who wish to develop and enhance their competencies and skills. The program focuses on the basic areas of ethics, character development, audio and video production, and design using visualization software. The program finishes with a performance-based unit that requires students to develop their own gaming environment. This comprehensive project component provides practical experience toward developing a portfolio of work. Membership is encouraged in student organizations that promote technological literacy, leadership, and problem solving, resulting in personal growth and opportunity.

College, Career, and Certifications

Research with Mississippi industry suggests that this curriculum should be written to the Autodesk Certified Associate Certification. This exam assesses the foundation of animation skills students need to create effective animation using game design tools.

Grade Level and Class Size Recommendations

It is recommended that students enter this program as 10th graders. Exceptions to this are a district-level decision based on class size, enrollment numbers, and maturity of student. The classroom and lab are designed to accommodate a maximum of 15 students.

Student Prerequisites

For students to experience success in the program, the following student prerequisites are suggested:

1. C or higher in English (the previous year)
2. C or higher in high school level math (last course taken or the instructor can specify the level of math instruction needed)
3. Instructor approval and TABE reading score (eighth grade or higher)

or

1. TABE reading and math score (eighth grade or higher)
2. Instructor approval

or

1. Instructor approval

Assessment

The latest assessment blueprint for the curriculum can be found at rcu.msstate.edu/Curriculum/CurriculumDownload.

~~Applied Academic Credit~~

~~The latest academic credit information can be found at mdek12.org/ESE/Approved-Course-for-the-Secondary-Schools.~~

~~Teacher Licensure~~

~~The latest CTE teacher licensure information can be found at mdek12.org/OTL/OEL/career&technical.~~

~~Professional Learning~~

~~If you have specific questions about the content of any of training sessions provided, please contact the RCU at 662-325-2510.~~

Course Outlines

Option 1—Four 1-Carnegie Unit Courses

This curriculum consists of four 1-credit courses, which should be completed in the following sequence:

1. **Ethics, Design Theory, and Photography—Course Code: 994402**
2. **Design Visualization and Character Development—Course Code: 994403**
3. **Audio and Video Production—Course Code: 994404**
4. **Business, Evaluation, and Development of Simulation and Animation Projects—Course Code: 994405**

Course Description: Ethics, Design Theory, and Photography
This course identifies the foundation skills necessary in the game design industry. Content areas such as safety, ethical issues, video game history, career opportunities, game mechanics, and photography are offered to students.

Course Description: Design Visualization and Character Development
This course emphasizes real-world, hands-on practice. Content related to illustration, level design, character development, and animation is offered to students. This 1-Carnegie unit course should only be taken after students successfully pass Ethics, Design Theory, and Photography.

Course Description: Audio and Video Production
This course focuses on audio design, programming, and video production. This one-Carnegie unit course should only be taken after students successfully pass Design Visualization and Character Development.

Course Description: Business, Evaluation, and Development of Simulation and Animation Projects
This is the capstone course that gives students the opportunity to produce a final video game project that incorporates the skill and knowledge learned in the first three simulation and animation design courses and showcases what they have learned and accomplished. Upon the completion of this course, students also will have put the finishing touches on a video game portfolio that is cumulative of their work throughout all semesters of simulation and animation design.

Ethics, Design Theory, and Photography—Course Code: 994402

Unit	Unit Name	Hours
1	Introduction, Safety, and Orientation	10
2	Ethics in the Game Design Industry	20
3	Games and Society	20
4	Game Design Theory and Mechanics	60
5	Image Editing for Game Design	30
Total		140

Design Visualization and Character Development – Course Code: 994403

Unit	Unit Title	Hours
6	Artistic Rendering Using Illustration Software	30
7	Introduction to 3-D Modeling	30
8	Level Design Using Design Visualization Software	30
9	Character Development and Animation	50
Total		140

Audio and Video Production – Course Code: 994404

Unit	Unit Title	Hours
10	Video Game Production	40
11	Audio Design	40
12	Video Game Programming	60
Total		140

Business, Evaluation, and Development of Simulation and Animation Projects – Course Code: 994405

Unit	Unit Title	Hours
13	Marketing for Gaming	30
14	Game Evaluation	10
15	SAD Seminar and Experience	80
16	Professional Portfolio Development	20
Total		140

Option 2 – Two 2-Carnegie Unit Courses

This curriculum consists of two 2-credit courses, which should be completed in the following sequence:

1. **Simulation and Animation Design I – Course Code: 994400**
2. **Simulation and Animation Design II – Course Code: 994401**

Course Description: Simulation and Animation Design I

This course encompasses the foundation skills necessary in the game design industry. Content such as safety, ethical issues, video game history, career opportunities, game mechanics, and photography, with emphasis placed on real-world, hands-on practice related to illustration, level design, character development, and animation is offered to students. Students will receive two Carnegie units upon completion of the course.

Course Description: Simulation and Animation Design II

This course focuses on audio design, programming, and video game production. This course gives students the opportunity to produce a final video game project that incorporates the skills and knowledge learned in the Simulation and Animation Design I course, allowing the students the chance to showcase what they have learned and accomplished. Upon the completion of this course, the students also will have put the finishing touches on a video game portfolio that is

cumulative of their work throughout all semesters of simulation and animation design. Students will receive 2 Carnegie units upon completion of the course.

Simulation and Animation Design I – Course Code: 994400

Unit	Unit Name	Hours
1	Introduction, Safety, and Orientation	10
2	Ethics in the Game Design Industry	20
3	Games and Society	20
4	Game Design Theory and Mechanics	60
5	Image Editing for Game Design	30
6	Artistic Rendering Using Illustration Software	30
7	Introduction to 3-D Modeling	30
8	Level Design Using Design Visualization Software	30
9	Character Development and Animation	50
Total		280

Simulation and Animation Design II – Course Code: 994401

Unit	Unit Title	Hours
10	Video Game Production	40
11	Audio Design	40
12	Video Game Programming	60
13	Marketing for Gaming	30
14	Game Evaluation	10
15	SAD Seminar and Experience	80
16	Professional Portfolio Development	20
Total		280

Research Synopsis

Introduction

Computer game simulators and animators create and design the animation, mechanics, and interfaces for interactive computer programs. Most jobs in this field require a bachelor's degree. Having a strong portfolio of work and learning the technical skills needed for this career are also needed to succeed in this industry. Careers in this field include software developer, computer programmer, 3-D artist, and multimedia designer. Computer game simulators and animators usually work for computer consulting firms, gaming companies, entertainment studios, or software development firms. Careers as military simulation programmers, crime scene investigation software developers, and corporate training software developers are also available.

Needs of the Future Workforce

In Mississippi, jobs in this career field are projected to have an overall growth of about 10 percent from 2014 to 2024. Projected growth will be due to an increased demand for software developers and audio-visual and multimedia collections specialists.

Table 1.1: Current and Projected Occupation Report

Description	Jobs, 2014	Projected Jobs, 2024	Change (Number)	Change (Percent)	Average Hourly Earning
Multimedia Artists and Animators	30	30	0	0.0	$25.43
Software Developers, Systems Software	840	890	50	6.0	$41.32
Software Developers, Applications	880	1,010	130	14.8	$45.42
Media and Communication Workers	20	20	0	0.0	$19.52
Art Directors	130	130	0	0.0	$28.99
Graphic Designers	790	790	0	0.0	$18.97
Audio-Visual and Multimedia Collections Specialists	130	140	10	7.7	$16.92

Source: Mississippi Department of Employment Security; www.mdes.ms.gov (2018).

Perkins IV Requirements

The SAD curriculum meets Perkins IV requirements of introducing students to and preparing students for high-skill, high-wage, and/or high-demand occupations. It also offers students programs of study including secondary, postsecondary, and IHL courses that will prepare them for occupations in these fields. Additionally, the SAD curriculum is integrated with Mississippi's college- and career-readiness standards. Lastly, the SAD curriculum focuses on ongoing and meaningful professional development for teachers, as well as relationships with industry.

Curriculum Content: Summary of Standards

The standards to be included in the simulation and animation design curriculum are the College and Career Ready Standards for the arts, audio-video technology, and communications career cluster, 21st Century Skills, and the National Educational Technology Standards (NETS) for Students. Combining these standards to create this document will result in highly skilled, well-rounded students who are prepared to enter a secondary academic or career and technical program of study. They will also be prepared to academically compete nationally as the college- and career-readiness standards are designed to prepare students for success in community colleges, institutions of higher learning, and careers.

Academic Infusion

The SAD curriculum is tied to the college- and career-readiness standards for English language arts and mathematics. The curriculum provides multiple opportunities for students to apply and reinforce the core academic skills required in the workforce and to further their education at the postsecondary level. Students will apply mathematical reasoning, critical thinking, and problem-solving techniques to work-related problems as they progress through the program. Students will be required to locate, synthesize, and use information from charts, tables, forms, diagrams, and instrument gauges. Students will sharpen their writing and reading comprehension skills through scripting, locating, and interpreting written information. College- and career-ready standards for each unit are in Appendix E.

Transition to Postsecondary Education

The latest articulation information for secondary to postsecondary can be found at the Mississippi Community College Board website, mccb.edu/.

Conclusions

In Mississippi, most employment opportunities will be in software development and as multimedia specialists that prepare, plan, and operate multimedia teaching aids for use in education. Animation and simulation skills can also be used to develop simulation programs for the military and law enforcement, and for human resources training. The SAD curriculum will be filled with opportunities for students to develop their skills in critical thinking, problem solving, mathematics, reading comprehension, and writing. The curriculum document will be updated regularly to reflect the needs of the workforce.

~~Professional Organizations~~

~~Future Business Leaders of America~~
~~fbla-pbl.org~~

~~International Game Developers Association~~
~~igda.org~~

~~Technology Student Association~~
~~tsaweb.org~~

~~Association of Career and Technical Education~~
~~acteonline.org~~

~~International Society for Technology in Education~~
~~iste.org~~

Using This Document

Suggested Time on Task

This section indicates an estimated number of clock hours of instruction that should be required to teach the competencies and objectives of the unit. A minimum of 140 hours of instruction is required for each Carnegie unit credit. The curriculum framework should account for approximately 75-80% of the time in the course. The remaining percentage of class time will include instruction in non-tested material, review for end-of-course testing, and special projects.

Competencies and Suggested Objectives

A competency represents a general concept or performance that students are expected to master as a requirement for satisfactorily completing a unit. Students will be expected to receive instruction on all competencies. The suggested objectives represent the enabling and supporting knowledge and performances that will indicate mastery of the competency at the course level.

Integrated Academic Topics, 21st Century Skills and Information and Communication Technology Literacy Standards, ACT College Readiness Standards, and Technology Standards for Students

This section identifies related academic topics as required in the Subject Area Testing Program in Algebra I, Biology I, English II, and U.S. History from 1877, which are integrated into the content of the unit. Research-based teaching strategies also incorporate ACT College Readiness standards. This section also identifies the 21st Century Skills and Information and Communication Technology Literacy skills. In addition, national technology standards for students associated with the competencies and suggested objectives for the unit are also identified.

References

A list of suggested references is provided for each unit within the accompanying teacher resource document. The list includes some of the primary instructional resources that may be used to teach the competencies and suggested objectives. Again, these resources are suggested, and the list may be modified or enhanced based on needs and abilities of students and on available resources. The teacher resource document can be downloaded at rcu.msstate.edu/Curriculum/CurriculumDownload.aspx

Enrichment Material

Many of the units include an enrichment section at the end. This section of material will not be tested on the Mississippi Career Planning and Assessment System (MS-CPAS), however it will greatly enhance the learning experiences for the students. It is suggested to use the enrichment material when needed or desired by the teacher and if time allows in the class.

Unit 1: Introduction, Safety, and Orientation

Competencies and Suggested Objectives
1. Identify course expectations, school policies, program policies, and safety procedures related to SAD. DOK1 a. Identify course expectations, school policies, and program policies related to game design technology (GDT). b. Apply safety procedures in the computer classroom and lab.
2. Explore personality development, leadership, and teamwork in relation to the classroom environment, and interpersonal skills. DOK2 a. Identify potential influences that shape personality development, including personality traits, heredity, and environment. b. Develop a report on how personality traits affect teamwork and leadership skills. c. Identify forces that shape personality development including personality traits, heredity, and environment. d. Develop effective leadership, decision-making, and communication skills.

Unit 2: Ethics in the Game Design Industry

Competencies and Suggested Objectives
1. Research copyright rules, regulations, and issues related to graphics and images produced by others and original work; adhere to those rules and regulations when developing work. DOK1 a. Evaluate terms related to copyright rules, regulations, and issues related to graphics and images produced by others and original work. b. Research copyright laws related to graphics, images, video games, sounds, and other original work. c. Identify copyright violations related to trademark, symbols, length of time, and public domain.
2. Research online content, and evaluate content bias, currency, and source. DOK2 a. Evaluate potential bias in searching for information online. b. Compare information with multiple sources. c. Research plagiarism and the consequences of plagiarizing. d. Design a project using images, songs, sounds, and video that meet copyright guidelines.
3. Research the Entertainment Software Ratings Board (ESRB). DOK1 a. Identify the purpose of ESRB. b. Compare the similarities and differences between game ratings.

Unit 3: Games and Society

Competencies and Suggested Objectives
1. Explore how games reflect and construct individuals and groups. DOK1 a. Research the evolution of technology and its impact on the gaming culture. b. Identify and explain the game market and the reasons why people play video games.
2. Research and identify goals and game genres. DOK2 a. Obtain and evaluate non-entertainment goals associated with games. b. Identify the characteristics associated with game genres. c. Evaluate the effects player motivation has on the types of games developed.
3. Research and identify careers and roles within the game design and development industry. DOK2 a. Research the responsibilities of producers, programmers, artists, designers, riggers, animators, modelers, writers, and quality assurance personnel in relation to the daily operation of a game design company, including budget and schedule development, personnel management, and progress tracking. b. Determine job outlooks for producers, programmers, artists, designers, and quality assurance personnel. c. Develop the organizational structure of a game design company.
Enrichment:
1. Discuss the future of video games. a. Research the future of game design and development in terms of new technology and education. b. Discuss the concept of an ideal game of the future.

Unit 4: Game Design Theory and Mechanics

Competencies and Suggested Objectives
1. Identify the core components of game design theory and mechanics. DOK1 a. Analyze the core components of game design theory and mechanics. b. Research storytelling traditions and how they influence game ideas. c. Identify the steps in creating and editing a game design document.
2. Research and develop stories to include elements of various story structures using core components of game design theory. DOK2 a. Examine the use of a traditional story/three-act plot structure. b. Develop a story based on the monomyth story structure. c. Explore story elements. d. Create storyboards based on a single story plot structure.
3. Identify the character creation process. DOK1, AR VIS 2 a. Explore the elements of a character's identity. b. Explain how tone, audience, and purpose impact character identity development. c. Explore the design sequence rules and regulations for game design.
4. Apply design principles and techniques in the creation of 2-D and 3-D characters. DOK2 a. Research design principles and techniques for use in planning, designing, and producing a game character. b. Create concept art using sketches that demonstrates understanding of its role in game design. Use digital drawing tablets to create 2-D and 3-D concepts based on these sketches.
5. Identify the rules of play in GDT. DOK1 a. Explore the relationship between gameplay and game story. b. Research and explain how rules of play can be used in GDT. c. Analyze the structure of game rules. • How should games be structured? • How do you create balance within a game?

Unit 5: Image Editing for Game Design

Competencies and Suggested Objectives

1. Use photo-editing software to create and edit a product for a customer. DOK3
   a. Using a graphic organizer, evaluate the purpose of photo-editing software and its application.
   b. Demonstrate how to open/import and save an image from external sources (such as digital camera, scanner, phone, etc.).
   c. Evaluate the various file types per job needed:
      - JPEG
      - PNG
      - GIF
      - BMP
      - TIFF
   d. Identify and demonstrate the tools and concepts of photo-editing software.
      - Selection tools
      - Crop tools
      - Retouching tools
      - Painting tools
      - Drawing and type tools
      - Layers
      - Mode
      - Adjustments
      - Filters
      - Histogram
      - Automatic color correction
      - Image
      - Canvas size
      - Transform
   e. Identify and demonstrate proper resolution for incorporating an image in photo-editing software.

Unit 6: Artistic Rendering Using Illustration Software

Competencies and Suggested Objectives
1. Explore the elements of visual design in relation to game design. DOK1 a. Ask questions to generate a hypothesis regarding the visual elements that make up a video game. b. Ask questions to determine the basic elements of an image. c. Research the element of color and number of colors related to game design. d. Demonstrate the manipulation of images with the use of software commands.
2. Apply appropriate use of illustration software. DOK2 a. Explore and discuss the tools, features, and preferences within the illustration software. b. Distinguish between the two types of digital images – bitmap and vector (PDF, AI, EPS, SVG). c. Design a project to demonstrate mastery of illustration software (character creation).
Enrichment:
1. Differentiate between the use of value and texture in illustrative art. 2. Explore spatial illusions using illustration software.

Unit 7: Introduction to 3-D Modeling

Competencies and Suggested Objectives
1. Develop an understanding of design visualization software effectively and productively with the user interface (UI). DOK1 a. Interact with the UI components in the design interface. • Viewports • Toolbars • Menus • Command panels • Dialog boxes • Controls • Keyboard shortcuts
2. Manage design visualization software file input and output. DOK2 a. Start a new project and work on an existing project. b. Save a project for the first time and subsequent times. c. Merge files. d. Import and export files. e. Link and attach files.
3. Set an environment for working with design visualization software, and create objects using basic geometry. DOK2 a. Create and manipulate objects using basic geometry. b. Set preferences and tool options in the user interface. c. Use simple geometry and pivot points in relation to design visualization software. d. Transform objects using the basic transform commands. e. Use align tools. f. Make duplicate objects (cloning).
4. Design, create, and analyze the visual component of games. DOK3 a. Compare the basic elements of a shape through modeling. b. Create game-ready low polygon models.

Unit 8: Level Design Using Design Visualization Software

Competencies and Suggested Objectives
1. Identify the fundamental architectural and structural principles of level design in relation to game environments. DOK1 a. Research the history of architecture and how it relates to realistic game environments. b. Explore the relationship of level design and gameplay – what events occur in each level. c. Compare the similarities and differences between real-world spaces and game spaces.
2. Create, manipulate, and analyze the visual components of the game world. DOK2 a. Identify and manipulate mapping coordinates. b. Evaluate how mapping coordinates work and how to manipulate those coordinates using modifiers in the design visualization software. c. Evaluate the creation of basic materials and the assignment of those materials to objects in a game scene. d. Construct space design by layering multiple texture maps onto a surface to create a composite image using design visualization software. e. Apply sub-maps on similar objects to give unique identity.
3. Manipulate 3-D aspects of the world design by adjusting cameras and lighting and adding special effects. DOK3 a. Identify camera perspective and the effects on the game world and gameplay. b. Create a camera and adjust camera angle and perspective. c. Use different lighting methods. d. Use particle systems, lens effects, and constraints to create special effects in a game world.

Unit 9: Character Development and Animation

Competencies and Suggested Objectives
1. Develop an understanding of the principles and history of visual asset generation. DOK1 a. Research the developments in the history of game design and animation. b. Identify character types and archetypes in relationship to character development. c. Explain ways that characters develop throughout the course of a game. d. Develop character identity through names, verbal, and visual character development. e. Analyze the differences in characters from various media types.
2. Examine the process of developing visual assets. DOK1 a. Recognize the importance of time in animation. b. Examine the process of animation and animation techniques. c. Identify the characteristics of reactive animation. d. Analyze and edit animation curves, path constraints, and alternative pivot points. e. Analyze hierarchical animation.
3. Create a 3-D model/time-based animation. DOK2 a. Create animation projects using time in animation; animation techniques; reactive animation; animation curves, path constraints, and alternative pivot points; and hierarchical animation.
Enrichment:
1. Develop a more extensive project with additional, optional elements listed.

Unit 10: Video Game Production

Competencies and Suggested Objectives
1. Identify the company and team roles and responsibilities related to the game-development process. DOK1 a. Describe the elements of leadership and the qualities necessary to become a successful leader. b. Identify the company roles related to the game-development process. c. Identify game-development team roles involved in the game-development process. d. Explain the phases associated with developing a game from concept to completion. e. Explain the five-stage team management model and how it can be used in the game-development process. f. Explain and demonstrate how to conduct meetings.
2. Apply time and project-management skills. DOK2 a. Explain the components of each stage in the game development process. b. Create a timeline for a game project demonstrating all phases of game development (e.g., concept, preproduction, production. alpha, beta, gold, postproduction)
Enrichment:
1. Plan, create, interpret, and analyze budgets for game design and development. a) Discuss the elements of a game design budget. b) Plan, construct, interpret, and analyze a game design budget.

Unit 11: Audio Design

Competencies and Suggested Objectives
1. Research audio history and theory. DOK1 a. Discuss the components of audio and game design. b. Discuss the history of audio components and their importance in game design.
2. Describe the components of a sound system and game audio formats. DOK1 a. Research and explain the differences and uses of compressed and uncompressed formats in game projects. b. Analyze the differences between audio formats. • MP3 • OGG • WAV • AIFF c. Analyze how bit rate and sample rate affect file size and quality and provide supporting evidence. d. Identify recording hardware commonly used in game audio development. e. Identify digital audio workstation software packages used in the game development industry. f. Research how audio *middleware* software is used in conjunction with game engines.
3. Understand the functions of audio design fundamentals (creating the atmosphere) and interactive audio for game design. DOK2 a. Describe how sound can set the mood for a game. b. Create digital sound effects. c. Describe the purpose and primary functions of music in video games. d. Demonstrate music composition. e. Research and explain voice-overs and how they add personality to game characters. f. Demonstrate the creation, editing, and testing of voice-overs.
Enrichment:
1. Examine the fundamentals of 3-D audio and blending video game audio elements. a. Describe the audio asset assembly, delivery, and priority process. b. Demonstrate the difference between occlusion and obstruction and the effect on game audio. c. Describe the effect technology has had in the past and may have in the future on game audio.

Scenario

A video game company has hired you to update one of its classic games. The audio team will create, edit, and implement all sounds for the provided gameplay clip to present your concept.

1. Create an asset list for the project.
2. Determine responsibilities for each team member
3. Create the audio elements for the presentation video.
    a. Background music
    b. Sound effects
    c. Vocal effects
4. Use video editing software to produce an updated, edited video clip that implements the new audio elements

Unit 12: Video Game Programming

Competencies and Suggested Objectives
1. Analyze the structure of a video game programming language. DOK2 a. Define the terms associated with video game programming. b. Discuss the various types of programming languages used in video game development. c. Explain the program development cycle and include pseudocode, input/output, processing, and storage. d. Demonstrate text output to the screen using a programming language. e. Classify variable and constants. f. Create, run, and debug an original program to input data, process data, and print a report. g. Create programs that perform calculations using arithmetic operations to include addition, subtraction, multiplication, division, and exponentiation. h. Order of Operations (parenthesis->exponents->mult/div->add/sub) i. Create programs that include decision, selection, and iteration statements to include if/then statements, case statements, do loops, and for/next loops.
2. Analyze the purpose, importance, and structure of game engines. DOK1 a. Research and identify the most commonly used game engines (e.g., Gamemaker, GameSalad, Clickteam Fusion, Unity3D, Unreal Engine). b. Discuss the importance of game engines in the game development process. c. Identify the UI elements of the game design engine (e.g., workspaces, shelves, inspector, library, panels, menus, etc.). d. Create and/or modify game code using a game engine.

Unit 13: Marketing for Gaming

Competencies and Suggested Objectives
1. Explain the importance of audience knowledge and target marketing in GDT. DOK 2 a. Identify target markets and how to sell video games. b. Explain demographic segmentation and how it can be used in a marketing campaign. c. Identify marketing tools and how each can be used to attract buyers to a product. d. Compare and contrast the areas of the distribution process.
2. Research consumer behavior and publisher relations within the functions of marketing, such as advertising, public relations, sales, and promotions. DOK2 a. Assess consumer behavior and the influence it can have on the functions of marketing. b. Research how game companies and publishers work together to bring a game to market. c. Research contracts between game companies and publishers.
3. Research and analyze the economics of the video game industry. DOK2 a. Investigate the supply chain and how the economy is affected. b. Analyze and predict costs and profits for video games.

Unit 14: Game Evaluation

Competencies and Suggested Objectives
1. Discuss quality assurance (QA) and the role it plays in game design. DOK1 a. Identify the various stages of QA for game development. b. Identify best practices regarding QA.
2. Explore and understand video game architecture through testing, defect tracking, technical reviews, and inspections. DOK2 a. Identify the elements of game architecture and the evaluation process. b. Apply the process of bug testing and reporting. c. Analyze the bug-fixing process.
3. Critically evaluate game design, character development, character animation, sound design, playability, and compatibility. DOK2 a. Classify the testing priority of elements of game design, character development and animation, sound design, playability, and compatibility. b. Design and develop a video game evaluation plan. c. Demonstrate the process of correcting game problem areas and satisfying QA requirements.

Unit 15: SAD Seminar and Experience

Competencies and Suggested Objectives
1. Apply practical video game design mechanics, programming, visual and audio elements, and production techniques while working in teams. DOK3 a. Research and apply brainstorming processes to create a concept for a game or animation. b. Develop a high concept document for the game. c. Organize a team into specific task areas with a project leader. d. Create a task list or chart elements to be created by specific departments. e. Create concept art and storyboards for the project. f. Research and develop a marketing strategy. g. Develop a test plan. h. Create supporting documentation needed (e.g., audio asset list, menu scripts, dialog scripts, pseudocode, etc.). i. Collect and organize documents into a game design document. j. Create a playable demo of a video game or animation based on the game design document.

Unit 16: Professional Portfolio Development

Competencies and Suggested Objectives
1. Develop a professional portfolio. DOK3 a. Research and identify the purpose of a portfolio as it relates to career planning. b. Construct an e-portfolio consisting of a resumé and examples of work that demonstrate skills acquired in SAD classes.

Student Competency Profile

Student's Name: _____

This record is intended to serve as a method of noting student achievement of the competencies in each unit. It can be duplicated for each student, and it can serve as a cumulative record of competencies achieved in the course.

In the blank before each competency, write in the date on which the student mastered the competency.

Unit 1: Introduction, Safety, and Orientation		
	1.	Identify course expectations, school policies, program policies, and safety procedures related to simulation and animation design (SAD).
	2.	Explore personality development, leadership, and teamwork in relation to the classroom environment, and interpersonal skills.
Unit 2: Ethics in the Game Design Industry		
	1.	Research copyright rules, regulations, and issues related to graphics and images produced by others and original work; adhere to those rules and regulations when developing work.
	2.	Research online content and evaluate content bias, currency, and source.
	3.	Research the Entertainment Software Ratings Board (ESRB).
Unit 3: Games and Society		
	1.	Explore how games reflect and construct individuals and groups.
	2.	Research and identify goals and game genres.
	3.	Research and identify careers and roles within the game design and development industry.
Unit 4: Game Design Theory and Mechanics		
	1.	Identify the core components of game design theory and mechanics.
	2.	Detail the character creation process.
	3.	Apply design principles and techniques in the creation of a 2-D and 3-D character.
	4.	Identify the rules of play in game design technology (GTD).
Unit 5: Image Editing for Game Design		
	1.	Use photo-editing software to create and edit a product for a customer.
Unit 6: Artistic Rendering Using Illustration Software		
	1.	Explore the elements of visual design in relation to game design.
	2.	Apply appropriate use of illustration software.

Unit 7: Introduction to 3-D Modeling		
	1.	Develop an understanding of design visualization software effectively and productively with the user interface (UI).
	2.	Manage design visualization software file input and output.
	3.	Set an environment for working with design visualization software and create objects using basic geometry.
	4.	Design, create, and analyze the visual component of games
Unit 8: Level Design Using Design Visualization Software		
	1.	Identify the fundamental architectural and structural principles of level design in relation to game environments.
	2.	Create, manipulate, and analyze the visual components of the game world.
	3.	Manipulate 3-D aspects of the world design by adjusting cameras and lighting and adding special effects.
Unit 9: Character Development and Animation		
	1.	Develop an understanding of the principles and history of visual-asset generation.
	2.	Examine the process of developing visual assets.
	3.	Create a 3-D model/time-based animation.
Unit 10: Video Game Production		
	1.	Identify the company and team roles and responsibilities related to the game development process.
	2.	Apply time and project-management skills.
Unit 11: Audio Design		
	1.	Research audio history and theory.
	2.	Describe the components of a sound system and game audio formats.
	3.	Understand the functions of audio design fundamentals (creating the atmosphere) and interactive audio for game design.
Unit 12: Video Game Programming		
	1.	Analyze the structure of a video game programming language.
	2.	Analyze the purpose, importance, and structure of game engines.
Unit 13: Marketing for Gaming		
	1.	Explain the importance of audience knowledge and target marketing in GDT.
	2.	Research consumer behavior and publisher relations within the functions of marketing, such as advertising, public relations, sales, and promotions.
	3.	Research and analyze the economics of the video game industry.
Unit 14: Game Evaluation		
	1.	Discuss quality assurance (QA) and the role it plays in game design.
	2.	Explore and understand video game architecture through testing, defect tracking, technical reviews, and inspections.

	~~3.~~	~~Critically evaluate game design, character development, character animation, sound design, playability, and compatibility.~~
~~Unit 15: SAD Seminar and Experience~~		
	~~1.~~	~~Apply practical video game design mechanics, programming, visual and audio elements, and game production techniques while working in teams.~~
~~Unit 16: Professional Portfolio Development~~		
	~~1.~~	~~Develop a professional portfolio.~~

Appendix A: Industry Standards

NBEA Standards

Crosswalk for Animation and Simulation Design																	
	Units	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8	Unit 9	Unit 10	Unit 11	Unit 12	Unit 13	Unit 14	Unit 15	Unit 16
Arts, A/V Technology & Communications Career Cluster																	
AR 1				X													
AR 2		X				X								X			
AR 3		X		X			X										
AR 4			X														
AR 5				X													
AR 6					X								X	X			
Visual Arts Career Pathway																	
AR-VIS 1				X						X		X			X	X	
AR-VIS 2			X		X	X	X	X	X	X	X	X	X		X	X	X
AR-VIS 3							X	X	X	X	X	X	X				

Appendix B: 21st Century Skills[1]

Framework for 21st Century Learning Crosswalk for Simulation and Animation Design																						
	Units	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Standards																						
CS1		X		X	X						X			X		X					
CS2		X	X								X			X		X						
CS3		X	X	X																		
CS4		X		X																		
CS5																						
CS6		X	X		X	X	X	X	X	X	X	X	X			X	X					
CS7		X			X	X	X	X	X	X	X	X	X	X	X	X						
CS8		X			X						X	X				X	X					
CS9		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					
CS10			X		X	X	X	X	X	X	X	X	X		X	X	X					
CS11					X	X	X	X	X	X	X	X	X		X	X	X					
CS12		X		X																		
CS13		X			X	X	X	X	X	X	X	X	X	X	X	X	X					
CS14		X		X							X				X	X						
CS15			X		X		X	X	X	X	X	X	X			X	X					
CS16		X	X	X							X			X		X						

CSS1 21st Century Themes

CS1 Global Awareness

1. Using 21st century skills to understand and address global issues
2. Learning from and working collaboratively with individuals representing diverse cultures, religions, and lifestyles in a spirit of mutual respect and open dialogue in personal, work, and community contexts
3. Understanding other nations and cultures, including the use of non-English languages

CS2 Financial, Economic, Business, and Entrepreneurial Literacy

1. Knowing how to make appropriate personal economic choices
2. Understanding the role of the economy in society
3. Using entrepreneurial skills to enhance workplace productivity and career options

CS3 Civic Literacy

1. Participating effectively in civic life through knowing how to stay informed and understanding governmental processes
2. Exercising the rights and obligations of citizenship at local, state, national, and global levels
3. Understanding the local and global implications of civic decisions

CS4 Health Literacy

1. Obtaining, interpreting, and understanding basic health information and services and using such information and services in ways that enhance health
2. Understanding preventive physical and mental health measures, including proper diet, nutrition, exercise, risk avoidance, and stress reduction
3. Using available information to make appropriate health-related decisions
4. Establishing and monitoring personal and family health goals

[1] *21st century skills.* (n.d.). Washington, DC: Partnership for 21st Century Skills.

5. Understanding national and international public health and safety issues

CS5 Environmental Literacy

1. Demonstrate knowledge and understanding of the environment and the circumstances and conditions affecting it, particularly as relates to air, climate, land, food, energy, water, and ecosystems.
2. Demonstrate knowledge and understanding of society's impact on the natural world (e.g., population growth, population development, resource consumption rate, etc.).
3. Investigate and analyze environmental issues, and make accurate conclusions about effective solutions.
4. Take individual and collective action toward addressing environmental challenges (e.g., participating in global actions, designing solutions that inspire action on environmental issues).

CSS2 Learning and Innovation Skills

CS6 Creativity and Innovation

1. Think Creatively
2. Work Creatively with Others
3. Implement Innovations

CS7 Critical Thinking and Problem Solving

1. Reason Effectively
2. Use Systems Thinking
3. Make Judgments and Decisions
4. Solve Problems

CS8 Communication and Collaboration

1. Communicate Clearly
2. Collaborate with Others

CSS3 Information, Media and Technology Skills

CS9 Information Literacy

1. Access and Evaluate Information
2. Use and Manage Information

CS10 Media Literacy

1. Analyze Media
2. Create Media Products

CS11 ICT Literacy

1. Apply Technology Effectively

CSS4 Life and Career Skills

CS12 Flexibility and Adaptability

1. Adapt to change
2. Be Flexible

CS13 Initiative and Self Direction

1. Manage Goals and Time
2. Work Independently
3. Be Self-directed Learners

~~CS14 Social and Cross-Cultural Skills~~

1. ~~Interact Effectively with others~~
2. ~~Work Effectively in Diverse Teams~~

~~CS15 Productivity and Accountability~~

1. ~~Manage Projects~~
2. ~~Produce Results~~

~~CS16 Leadership and Responsibility~~

1. ~~Guide and Lead Others~~
2. ~~Be Responsible to Others~~

Appendix C: 2016 International Society for Technology in Education Standards (ISTE)

ISTE Student Standards Crosswalk for Simulation and Animation Design																					
	Units	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Standards																						
T1			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					
T2		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					
T3		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					
T4			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					
T5			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					
T6			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					
T7														X		X						

T1 – Empowered Learner
T2 – Digital Citizen
T3 – Knowledge Constructor
T4 – Innovative Designer
T5 – Computational Thinker
T6 – Creative Communicator
T7 – Global Collaborator

T1 – Empowered Learner

Students leverage technology to take an active role in choosing, achieving and demonstrating competency in their learning goals, informed by the learning sciences. Students:

a. Articulate and set personal learning goals, develop strategies leveraging technology to achieve them and reflect on the learning process itself to improve learning outcomes.
b. Build networks and customize their learning environments in ways that support the learning process.
c. Use technology to seek feedback that informs and improves their practice and to demonstrate their learning in a variety of ways.
d. Understand the fundamental concepts of technology operations, demonstrate the ability to choose, use and troubleshoot current technologies and are able to transfer their knowledge to explore emerging technologies.

T2 – Digital Citizen

Students recognize the rights, responsibilities and opportunities of living, learning and working in an interconnected digital world, and they act and model in ways that are safe, legal and ethical. Students:

a. Cultivate and manage their digital identity and reputation and are aware of the permanence of their actions in the digital world.
b. Engage in positive, safe, legal and ethical behavior when using technology, including social interactions online or when using networked devices.

c. Demonstrate an understanding of and respect for the rights and obligations of using and sharing intellectual property.
d. Manage their personal data to maintain digital privacy and security and are aware of data-collection technology used to track their navigation online.

T3 Knowledge Constructor

Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others. Students:

a. Plan and employ effective research strategies to locate information and other resources for their intellectual or creative pursuits.
b. Evaluate the accuracy, perspective, credibility and relevance of information, media, data or other resources.
c. Curate information from digital resources using a variety of tools and methods to create collections of artifacts that demonstrate meaningful connections or conclusions.
d. Build knowledge by actively exploring real-world issues and problems, developing ideas and theories and pursuing answers and solutions.

T4 Innovative Designer

Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions. Students:

a. Know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.
b. Select and use digital tools to plan and manage a design process that considers design constraints and calculated risks.
c. Develop, test and refine prototypes as part of a cyclical design process.
d. Exhibit a tolerance for ambiguity, perseverance and the capacity to work with open-ended problems.

T5 Computational Thinker

Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions. Students:

a. Formulate problem definitions suited for technology-assisted methods such as data analysis, abstract models and algorithmic thinking in exploring and finding solutions.
b. Collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making.
c. Break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.
d. Understand how automation works and use algorithmic thinking to develop a sequence of steps to create and test automated solutions.

T6 Creative Communicator

Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals. Students:

a. Choose the appropriate platforms and tools for meeting the desired objectives of their creation or communication.
b. Create original works or responsibly repurpose or remix digital resources into new creations.
c. Communicate complex ideas clearly and effectively by creating or using a variety of digital objects such as visualizations, models or simulations.
d. Publish or present content that customizes the message and medium for their intended audiences.

T7 Global Collaborator

Students use digital tools to broaden their perspectives and enrich their learning by collaborating with others and working effectively in teams locally and globally. Students:

a. Use digital tools to connect with learners from a variety of backgrounds and cultures, engaging with them in ways that broaden mutual understanding and learning.
b. Use collaborative technologies to work with others, including peers, experts or community members, to examine issues and problems from multiple viewpoints.
c. Contribute constructively to project teams, assuming various roles and responsibilities to work effectively toward a common goal.
d. Explore local and global issues and use collaborative technologies to work with others to investigate solutions.

Appendix D: College and Career Ready Standards – English Language Arts

MS CCR ELA Crosswalk for Simulation and Animation Design																						
	Units	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Standards																						
RL.9.1		X			X							X	X	X	X	X						
RL.9.2																						
RL.9.3					X						X											
RL.9.4					X						X											
RL.9.5					X						X											
RL.9.6																						
RL.9.7																						
RL.9.8																						
RL.9.9					X																	
RL.9.10					X																	
RL.9.10																						
RI.9.3					X																	
RI.9.5																						
RI.9.6																						
RI.9.7																						
RI.9.8																						
RI.9.9																						
W.9.1			X		X																	
W.9.2			X		X																	
W.9.3																						
W.9.4					X																	
W.9.5					X																	
W.9.6																X						
W.9.7															X							
W.9.8			X	X										X								
W.9.9			X											X	X							
W.9.10														X	X							
SL.9.1		X	X	X	X					X				X	X	X						
SL.9.2			X																			
SL.9.3																						
SL.9.4			X	X							X			X	X							
SL.9.5		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					
SL.9.6			X	X							X			X								
L.9.1		X	X	X	X						X	X	X	X	X	X						
L.9.2			X	X	X						X			X	X	X	X					
L.9.3					X						X			X	X	X	X					
L.9.4					X						X			X	X	X						
L.9.5																						
L.9.6			X		X						X		X	X	X	X	X					
RL.10.10				X																		
RH.9-10.1			X	X	X						X			X								
RH.9-10.2				X																		
RH.9-10.3					X																	
RH.9-10.4					X																	
RH.9-10.5					X						X			X								
RH.9-10.6			X																			
RH.9-10.7			X																			
RH.9-10.8																						
RH.9-10.9			X		X																	
RH.9-10.10																						
RST.9-10.1					X																	
RST.9-10.2																						

RST.9-10.3			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					
RST.9-10.4			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					
RST.9-10.5			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					
RST.9-10.6			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					
RST.9-10.7																						
RST.9-10.8																						
RST.9-10.9			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					
RST.9-10.10																						
WHST.9-10.1																						
WHST.9-10.2																						
WHST.9-10.3																						
WHST.9-10.4																						
WHST.9-10.5																						
WHST.9-10.6			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					
WHST.9-10.7																						
WHST.9-10.8																						
WHST.9-10.9																						
WHST.9-10.10																						
RL.11.1																						
RL.11.2																						
RL.11.3																						
RL.11.4																						
RL.11.5																						
RL.11.6																						
RL.11.7																						
RL.11.8																						
RL.11.9																						
RL.11.10																						
RI.11.3		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					
RI.11.4		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					
RI.11.5																						
RI.11.6																						
RI.11.7		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					
RI.11.8																						
RI.11.9																						
RI.11.10																						
W.11.1				X	X																	
W.11.2		X		X	X		X			X	X	X	X	X		X	X					
W.11.3		X		X	X		X			X	X	X	X	X		X	X					
W.11.4		X		X	X		X				X		X			X	X					
W.11.5																						
W.11.6		X		X	X	X	X		X	X	X	X	X	X	X	X	X					
W.11.7		X	X	X	X	X	X		X	X	X	X	X	X	X	X	X					
W.11.8			X	X	X	X	X		X	X	X	X	X	X	X	X	X					
W.11.9			X	X	X	X	X			X	X	X	X	X	X	X	X					
W.11.10																						
SL.11.1		X		X							X	X	X	X		X	X					
SL.11.2		X	X	X	X						X	X				X	X					
SL.11.3		X												X								
SL.11.4					X					X	X					X						
SL.11.5			X	X	X		X		X	X	X	X	X	X		X	X					
SL.11.6				X												X						
L.11.1																						
L.11.2																						
L.11.3																						
L.11.4																						
RL.12.10																						
RH.11-12.1			X	X	X	X	X		X	X	X	X	X	X		X	X					
RH.11-12.2			X	X	X	X	X		X	X	X	X	X	X		X	X					
RH.11-12.3																						
RH.11-12.4																						
RH.11-12.5																						
RH.11-12.6																						
RH.11-12.7																						
RH.11-12.8																						

~~RH.11-12.9~~																					
~~RH.11-12.10~~																					
~~RST.11-12.1~~																					
~~RST.11-12.2~~																					
~~RST.11-12.3~~												~~x~~									
~~RST.11-12.4~~																					
~~RST.11-12.5~~																					
~~RST.11-12.6~~																					
~~RST.11-12.7~~																					
~~RST.11-12.8~~																					
~~RST.11-12.9~~																					
~~RST.11-12.10~~																					
~~WHST.11-12.1~~																					
~~WHST.11-12.2~~											~~x~~			~~x~~							
~~WHST.11-12.6~~																					
~~WHST.11-12.8~~																					

~~College and Career Ready English I~~

~~Reading Literature Key Ideas and Details~~

~~RL.9.1 Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.~~

~~RL.9.2 Determine a theme or central idea of a text and analyze in detail its development over the course of the text, including how it emerges and is shaped and refined by specific details; provide an objective summary of the text.~~

~~RL.9.3 Analyze how complex characters (e.g., those with multiple or conflicting motivations) develop over the course of a text, interact with other characters, and advance the plot or develop the theme.~~

~~Craft and Structure~~

~~RL.9.4 Determine the meaning of words and phrases as they are used in the text, including figurative and connotative meanings; analyze the cumulative impact of specific word choices on meaning and tone (e.g., how the language evokes a sense of time and place; how it sets a formal or informal tone).~~

~~RL.9.5 Analyze how an author's choices concerning how to structure a text, order events within it (e.g., parallel plots), and manipulate time (e.g., pacing, flashbacks) create such effects as mystery, tension, or surprise.~~

~~RL.9.6 Analyze a particular point of view or cultural experience reflected in a work of literature from outside the United States, drawing on a wide reading of world literature.~~

~~Integration of Knowledge and Ideas~~

~~RL.9.7 Analyze the representation of a subject or a key scene in two different artistic mediums, including what is emphasized or absent in each treatment (e.g., Auden's "Musée des Beaux Arts" and Breughel's Landscape with the Fall of Icarus).~~

~~RL.9.8 Not applicable to literature.~~

~~College and Career Ready English I~~

~~RL.9.9 Analyze how an author draws on and transforms source material in a specific work (e.g., how Shakespeare treats a theme or topic from Ovid or the Bible or how a later author draws on a play by Shakespeare).~~

~~Range of Reading and Level of Text Complexity~~

~~RL.9.10 By the end of grade 9, read and comprehend literature, including stories, dramas, and poems, in the grades 9-10 text complexity band proficiently, with scaffolding as needed at the high end of the range.~~

~~College and Career Ready English I~~

~~Reading Informational Text Key Ideas and Details~~

~~RI.9.3 Analyze how the author unfolds an analysis or series of ideas or events, including the order in which the points are made, how they are introduced and developed, and the connections that are drawn between them.~~

Craft and Structure

RI.9.5 Analyze in detail how an author's ideas or claims are developed and refined by particular sentences, paragraphs, or larger portions of a text (e.g., a section or chapter).

RI.9.6 Determine an author's point of view or purpose in a text and analyze how an author uses rhetoric to advance that point of view or purpose.

Integration of Knowledge and Ideas

RI.9.7 Analyze various accounts of a subject told in different mediums (e.g., a person's life story in both print and multimedia), determining which details are emphasized in each account.

RI.9.8 Delineate and evaluate the argument and specific claims in a text, assessing whether the reasoning is valid and the evidence is relevant and sufficient; identify false statements and fallacious reasoning.

RI.9.9 Analyze seminal U.S. documents of historical and literary significance (e.g., Washington's Farewell Address, the Gettysburg Address, Roosevelt's Four Freedoms speech, King's "Letter from Birmingham Jail"), including how they address related themes and concepts.

College and Career Ready English I

Writing Text Types and Purposes

W.9.1 Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.

W.9.1a Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among claim(s), counterclaims, reasons, and evidence.

W.9.1b Develop claim(s) and counterclaims fairly, supplying evidence for each while pointing out the strengths and limitations of both in a manner that anticipates the audience's knowledge level and concerns.

W.9.1c Use words, phrases, and clauses to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.

W.9.1d Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.

W.9.1e Provide a concluding statement or section that follows from and supports the argument presented.

W.9.2 Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.

W.9.2a Introduce a topic; organize complex ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.

W.9.2b Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.

W.9.2c Use appropriate and varied transitions to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.

College and Career Ready English I

W.9.2d Use precise language and domain-specific vocabulary to manage the complexity of the topic.

W.9.2e Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.

W.9.2f Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).

W.9.3 Write narratives to develop real or imagined experiences or events using effective technique, well-chosen details, and well-structured event sequences.

W.9.3a Engage and orient the reader by setting out a problem, situation, or observation, establishing one or multiple point(s) of view, and introducing a narrator and/or characters; create a smooth progression of experiences or events.

W.9.3b Use narrative techniques, such as dialogue, pacing, description, reflection, and multiple plot lines, to develop experiences, events, and/or characters.

W.9.3c Use a variety of techniques to sequence events so that they build on one another to create a coherent whole.

W.9.3d Use precise words and phrases, telling details, and sensory language to convey a vivid picture of the experiences, events, setting, and/or characters.
W.9.3e Provide a conclusion that follows from and reflects on what is experienced, observed, or resolved over the course of the narrative.

Production and Distribution of Writing

W.9.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1–3 above.)
W.9.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. (Editing for conventions should demonstrate command of Language standards 1–3 up to and including grades 9–10.)
W.9.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.

Research to Build and Present Knowledge

W.9.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

College and Career Ready English I

W.9.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.
W.9.9 Draw evidence from literary or informational texts to support analysis, reflection, and research.
W.9.9a Apply grades 9–10 Reading standards to literature (e.g., "Analyze how an author draws on and transforms source material in a specific work [e.g., how Shakespeare treats a theme or topic from Ovid or the Bible or how a later author draws on a play by Shakespeare]").
W.9.9b Apply grades 9–10 Reading standards to literary nonfiction (e.g., "Delineate and evaluate the argument and specific claims in a text, assessing whether the reasoning is valid and the evidence is relevant and sufficient; identify false statements and fallacious reasoning").

Range of Writing

W.9.10 Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes, and audience.

College and Career Ready English I

SL.9.1 Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.
SL.9.1a Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.
SL.9.1b Work with peers to set rules for collegial discussions and decision making (e.g., informal consensus, taking votes on key issues, presentation of alternate views), clear goals and deadlines, and individual roles as needed.
SL.9.1c Propel conversations by posing and responding to questions that relate the current discussion to broader themes or larger ideas; actively incorporate others into the discussion; and clarify, verify, or challenge ideas and conclusions.
SL.9.1d Respond thoughtfully to diverse perspectives, summarize points of agreement and disagreement, and, when warranted, qualify or justify their own views and understanding and make new connections in light of the evidence and reasoning presented.
SL.9.2 Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, orally) evaluating the credibility and accuracy of each source.

SL.9.3 Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric, identifying any fallacious reasoning or exaggerated or distorted evidence.

Presentation of Knowledge and Ideas

SL.9.4 Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.

College and Career Ready English I

SL.9.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.
SL.9.6 Adapt speech to a variety of contexts and tasks, demonstrating command of formal English when indicated or appropriate. (See grades 9–10 Language standards 1 and 3 for specific expectations.)

College and Career Ready English I
Language
Conventions of Standard English

L.9.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.
L.9.1a Use parallel structure.*
L.9.1b Use various types of phrases (noun, verb, adjectival, adverbial, participial, prepositional, absolute) and clauses (independent, dependent; noun, relative, adverbial) to convey specific meanings and add variety and interest to writing or presentations.
L.9.2 Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.
L.9.2a Use a semicolon (and perhaps a conjunctive adverb) to link two or more closely related independent clauses.
L.9.2b Use a colon to introduce a list or quotation.
L.9.2c Spell correctly

Knowledge of Language

L.9.3 Apply knowledge of language to understand how language functions in different contexts, to make effective choices for meaning or style, and to comprehend more fully when reading or listening
L.9.3a Write and edit work so that it conforms to the guidelines in a style manual (e.g., MLA Handbook, Turabian's Manual for Writers) appropriate for the discipline and writing type.

Vocabulary Acquisition and Use

L.9.4 Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grades 9–10 reading and content, choosing flexibly from a range of strategies.
L.9.4a Use context (e.g., the overall meaning of a sentence, paragraph, or text; a word's position or function in a sentence) as a clue to the meaning of a word or phrase.
L.9.4b Identify and correctly use patterns of word changes that indicate different meanings or parts of speech (e.g., analyze, analysis, analytical; advocate, advocacy).

College and Career Ready English I

L.9.4c Consult general and specialized reference materials (e.g., dictionaries, glossaries, thesauruses), both print and digital, to find the pronunciation of a word or determine or clarify its precise meaning, its part of speech, or its etymology.
L.9.4d Verify the preliminary determination of the meaning of a word or phrase (e.g., by checking the inferred meaning in context or in a dictionary).
L.9.5 Demonstrate understanding of figurative language, word relationships, and nuances in word meanings.
L.9.5a Interpret figures of speech (e.g., euphemism, oxymoron) in context and analyze their role in the text.
L.9.5b Analyze nuances in the meaning of words with similar denotations.

L.9.6 Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

College and Career Ready English II

Range of Reading and Level of Text Complexity

RL.10.10 By the end of grade 10, read and comprehend literature, including stories, dramas, and poems, at the high end of the grades 9-10 text complexity band independently and proficiently.

Grades 9-10: Literacy in History/SS

Reading in History/Social Studies Key Ideas and Details

RH.9-10.1 Cite specific textual evidence to support analysis of primary and secondary sources, attending to such features as the date and origin of the information.

RH.9-10.2 Determine the central ideas or information of a primary or secondary source; provide an accurate summary of how key events or ideas develop over the course of the text.

RH.9-10.3 Analyze in detail a series of events described in a text; determine whether earlier events caused later ones or simply preceded them.

Craft and Structure

RH.9-10.4 Determine the meaning of words and phrases as they are used in a text, including vocabulary describing political, social, or economic aspects of history/social science.

RH.9-10.5 Analyze how a text uses structure to emphasize key points or advance an explanation or analysis.

RH.9-10.6 Compare the point of view of two or more authors for how they treat the same or similar topics, including which details they include and emphasize in their respective accounts.

Integration of Knowledge and Ideas

RH.9-10.7 Integrate quantitative or technical analysis (e.g., charts, research data) with qualitative analysis in print or digital text.

RH.9-10.8 Assess the extent to which the reasoning and evidence in a text support the author's claims.

RH.9-10.9 Compare and contrast treatments of the same topic in several primary and secondary sources.

Range of Reading and Level of Text Complexity

RH.9-10.10 By the end of grade 10, read and comprehend history/social studies texts in the grades 9-10 text complexity band independently and proficiently.

Grades 9-10: Literacy in Science and Technical Subjects

Reading in Science and Technical Subjects Key Ideas and Details

RST.9-10.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

RST.9-10.2 Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.

RST.9-10.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

Craft and Structure

RST.9-10.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.

RST.9-10.5 Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).

RST.9-10.6 Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.

Integration of Knowledge and Ideas

RST.9-10.7 Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

RST.9-10.8 Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.

RST.9-10.9 Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts

Range of Reading and Level of Text Complexity

RST.9-10.10 By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently.

Grades 9-10: Writing in History/SS, Science, and Technical Subjects

Writing Text Types and Purposes

WHST.9-10.1 Write arguments focused on discipline-specific content.

WHST.9-10.1a Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among the claim(s), counterclaims, reasons, and evidence.

WHST.9-10.1b Develop claim(s) and counterclaims fairly, supplying data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form and in a manner that anticipates the audience's knowledge level and concerns.

WHST.9-10.1c Use words, phrases, and clauses to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.

WHST.9-10.1d Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.

WHST.9-10.1e Provide a concluding statement or section that follows from or supports the argument presented.

WHST.9-10.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

WHST.9-10.2a Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.

WHST.9-10.2b Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.

Grades 9-10

Writing in History/SS, Science, and Technical Subjects

WHST.9-10.2c Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among ideas and concepts.

WHST.9-10.2d Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers.

WHST.9-10.2e Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.

WHST.9-10.2f Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).

WHST.9-10.3 Not Applicable

Production and Distribution of Writing

WHST.9-10.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

WHST.9-10.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

WHST.9-10.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.

Research to Build and Present Knowledge

WHST.9-10.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

WHST.9-10.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.

WHST.9-10.9 Draw evidence from informational texts to support analysis, reflection, and research.

Grades 9-10

Writing in History/SS, Science, and Technical Subjects

Range of Writing

WHST.9-10.10 Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

English III

Reading Literature Key Ideas and Details

RL.11.1 Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text, including determining where the text leaves matters uncertain.

RL.11.2 Determine two or more themes or central ideas of a text and analyze their development over the course of the text, including how they interact and build on one another to produce a complex account; provide an objective summary of the text.

RL.11.3 Analyze the impact of the author's choices regarding how to develop and relate elements of a story or drama (e.g., where a story is set, how the action is ordered, how the characters are introduced and developed).

Craft and Structure

RL.11.4 Determine the meaning of words and phrases as they are used in the text, including figurative and connotative meanings; analyze the impact of specific word choices on meaning and tone, including words with multiple meanings or language that is particularly fresh, engaging, or beautiful. (Include Shakespeare as well as other authors.)

RL.11.5 Analyze how an author's choices concerning how to structure specific parts of a text (e.g., the choice of where to begin or end a story, the choice to provide a comedic or tragic resolution) contribute to its overall structure and meaning as well as its aesthetic impact.

RL.11.6 Analyze a case in which grasping a point of view requires distinguishing what is directly stated in a text from what is really meant (e.g., satire, sarcasm, irony, or understatement).

Integration of Knowledge and Ideas

RL.11.7 Analyze multiple interpretations of a story, drama, or poem (e.g., recorded or live production of a play or recorded novel or poetry), evaluating how each version interprets the source text. (Include at least one play by Shakespeare and one play by an American dramatist.)

RL.11.8 Not applicable to literature.

RL.11.9 Demonstrate knowledge of eighteenth-, nineteenth- and early-twentieth century foundational works of American literature, including how two or more texts from the same period treat similar themes or topics.

Range of Reading and Level of Text Complexity

RL.11.10 By the end of grade 11, read and comprehend literature, including stories, dramas, and poems, in the grades 11-CCR text complexity band proficiently, with scaffolding as needed at the high end of the range.

English III

Reading Informational Text Key Ideas and Details

Rl.11.3 Analyze a complex set of ideas or sequence of events and explain how specific individuals, ideas, or events interact and develop over the course of the text.

Craft and Structure

Rl.11.4 Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze how an author uses and refines the meaning of a key term or terms over the course of a text (e.g., how Madison defines faction in Federalist No. 10).

Rl.11.5 Analyze and evaluate the effectiveness of the structure an author uses in his or her exposition or argument, including whether the structure makes points clear, convincing, and engaging.

Rl.11.6 Determine an author's point of view or purpose in a text in which the rhetoric is particularly effective, analyzing how style and content contribute to the power, persuasiveness or beauty of the text.

Integration of Knowledge and Ideas

Rl.11.7 Integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a question or solve a problem.

Rl.11.8 Delineate and evaluate the reasoning in seminal U.S. texts, including the application of constitutional principles and use of legal reasoning (e.g., in U.S. Supreme Court majority opinions and dissents) and the premises, purposes, and arguments in works of public advocacy (e.g., The Federalist, presidential addresses).

Rl.11.9 Analyze seventeenth-, eighteenth-, and nineteenth-century foundational U.S. documents of historical and literary significance (including Them Declaration of Independence, the Preamble to the Constitution, the Bill of Rights, and Lincoln's Second Inaugural Address) for their themes, purposes, and rhetorical features.

Range of Reading and Level of Text Complexity

Rl.11.10 By the end of grade 11, read and comprehend literary nonfiction in the grades 11-CCR text complexity band proficiently, with scaffolding as needed at the high end of the range.

English III

Writing

W.11.1 Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.

W.11.1a Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences claim(s), counterclaims, reasons, and evidence.

W.11.1b Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant evidence for each while pointing out the strengths and limitations of both in a manner that anticipates the audience's knowledge level, concerns, values, and possible biases.

W.11.1c Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.

W.11.1d Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.

W.11.1e Provide a concluding statement or section that follows from and supports the argument presented.

W.11.2 Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.

W.11.2a Introduce a topic; organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.

English III

W.11.2b Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.

W.11.2c Use appropriate and varied transitions and syntax to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.

W.11.2d Use precise language, domain-specific vocabulary, and techniques such as metaphor, simile, and analogy to manage the complexity of the topic.

W.11.2e Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.

W.11.2f Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).

W.11.3 Write narratives to develop real or imagined experiences or events using effective technique, well-chosen details, and well-structured event sequences.

W.11.3a Engage and orient the reader by setting out a problem, situation, or observation and its significance, establishing one or multiple point(s) of view, and introducing a narrator and/or characters; create a smooth progression of experiences or events.

W.11.3b Use narrative techniques, such as dialogue, pacing, description, reflection, and multiple plot lines, to develop experiences, events, and/or characters.

W.11.3c Use a variety of techniques to sequence events so that they build on one another to create a coherent whole and build toward a particular tone and outcome (e.g., a sense of mystery, suspense, growth, or resolution).

W.11.3d Use precise words and phrases, telling details, and sensory language to convey a vivid picture of the experiences, events, setting, and/or characters.

W.11.3e Provide a conclusion that follows from and reflects on what is experienced, observed, or resolved over the course of the narrative.

Production and Distribution of Writing

W.11.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1–3 above.)

English III

W.11.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. (Editing for conventions should demonstrate command of Language standards 1–3 up to and including grades 11–12.)

W.11.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.

Research to Build and Present Knowledge

W.11.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

W.11.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.

W.11.9 Draw evidence from literary or informational texts to support analysis, reflection, and research.

W.11.9a Apply grades 11–12 Reading standards to literature (e.g., "Demonstrate knowledge of eighteenth-, nineteenth- and early-twentieth-century foundational works of American literature, including how two or more texts from the same period treat similar themes or topics").

W.11.9b Apply grades 11–12 Reading standards to literary nonfiction (e.g., "Delineate and evaluate the reasoning in seminal U.S. texts, including the application of constitutional principles and use of legal reasoning [e.g., in U.S. Supreme Court Case majority opinions and dissents] and the premises, purposes, and arguments in works of public advocacy [e.g., The Federalist, presidential addresses]").

Range of Writing

W.11.10 Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes, and audiences.

English III

Speaking and Listening

Comprehension and Collaboration

SL.11.1 Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 11–12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.

SL11.1a Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.

SL.11.1b Work with peers to promote civil, democratic discussions and decision making, set clear goals and deadlines, and establish individual roles as needed.

SL.11.1c Propel conversations by posing and responding to questions that probe reasoning and evidence; ensure a hearing for a full range of positions on a topic or issue; clarify, verify, or challenge ideas and conclusions; and promote divergent and creative perspectives.

SL.11.1d Respond thoughtfully to diverse perspectives; synthesize comments, claims, and evidence made on all sides of an issue; resolve contradictions when possible; and determine what additional information or research is required to deepen the investigation or complete the task.

SL.11.2 Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data.

SL.11.3 Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric, assessing the stance, premises, links among ideas, word choice, points of emphasis, and tone used.

Presentation of Knowledge and Ideas

SL.11.4 Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range of formal and informal tasks.

English III

SL11.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

SL.11.6 Adapt speech to a variety of contexts and tasks, demonstrating a command of formal English when indicated or appropriate. (See grades 11–12 Language standards 1 and 3 for specific expectations.)

English III

Language

Conventions of Standard English

L.11.1a Apply the understanding that usage is a matter of convention, can change over time, and is sometimes contested.

L.11.1b Resolve issues of complex or contested usage, consulting references (e.g., Merriam-Webster's Dictionary of English Usage, Garner's Modern American Usage) as needed.

L.11.2a Observe hyphenation conventions.

L.11.3a Vary syntax for effect, consulting references (e.g., Tufte's Artful Sentences) for guidance as needed; apply an understanding of syntax to the study of complex texts when reading.

Vocabulary Acquisition and Use

L.11.4 Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grades 11–12 reading and content, choosing flexibly from a range of strategies.

L.11.4b Identify and correctly use patterns of word changes that indicate different meanings or parts of speech (e.g., conceive, conception, conceivable).

English IV

Range of Reading and Level of Text Complexity

RL.12.10 By the end of grade 12, read and comprehend literature, including stories, dramas, and poems, at the high end of the grades 11–CCR text complexity band independently and proficiently.

Grades 11-12: Literacy in History/SS

Reading in History/Social Studies Key Ideas and Details

RH.11-12.1 Cite specific textual evidence to support analysis of primary and secondary sources, connecting insights gained from specific details to an understanding of the text as a whole.

RH.11-12.2 Determine the central ideas or information of a primary or secondary source; provide an accurate summary that makes clear the relationships among the key details and ideas.

RH.11-12.3 Evaluate various explanations for actions or events and determine which explanation best accords with textual evidence, acknowledging where the text leaves matters uncertain. Craft and Structure

RH.11-12.4 Determine the meaning of words and phrases as they are used in a text, including analyzing how an author uses and refines the meaning of a key term over the course of a text (e.g., how Madison defines faction in Federalist No. 10).

RH.11-12.5 Analyze in detail how a complex primary source is structured, including how key sentences, paragraphs, and larger portions of the text contribute to the whole.

RH.11-12.6 Evaluate authors' differing points of view on the same historical event or issue by assessing the authors' claims, reasoning, and evidence. Integration of Knowledge and Ideas

Rh.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, as well as in words) in order to address a question or solve a problem.

RH.11-12.8 Evaluate an author's premises, claims, and evidence by corroborating or challenging them with other information.

RH.11-12.9 Integrate information from diverse sources, both primary and secondary, into a coherent understanding of an idea or event, noting discrepancies among sources. Range of Reading and Level of Text Complexity

RH.11-12.10 By the end of grade 12, read and comprehend history/social studies texts in the grades 11–CCR text complexity band independently and proficiently.

Grades 11-12: Literacy in Science and Technical Subjects

Reading in Science and Technical Subjects Key Ideas and Details

RST. 11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.

RST.11-12.2 Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.

RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

Craft and Structure

RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics.

RST.11-12.5 Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.

RST.11-12.6 Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.

RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

Range of Reading and Level of Text Complexity

RST.11-12.10 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

Grades 11-12: Writing I History/SS, Science and Technical Subjects

Writing

Text Types and Purposes

WHST.11-12.1a Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence.

WHST.11-12.1b Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that anticipates the audience's knowledge level, concerns, values, and possible biases.

WHST.11-12.1c Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.

WHST.11-12.2a Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.

Grades 11-12: Writing I History/SS, Science and Technical Subjects

WHST.11-12.2d Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers.

Production and Distribution of Writing

WHST.11-12.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.

WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.

Appendix E: College and Career Ready Standards – Mathematics

MS CCR Mathematics Crosswalk for Simulation and Animation Design																					
	Units	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Standards																						
N-Q.1											X		X									
N-Q.2																						
N-Q.3																						
8.EE.8																						
A-SSE.1													X									
A-SSE.2																						
A-SSE.3																						
A-SSE.4																						
A-CED.1																						
A-CED.2																						
A-CED.3																						
A-CED.4																						
A-REI.2																						
A-REI.3																						
A-REI.4																						
A-REI.5																						
A-REI.6																						
A-REI.7																						
A-REI.8																						
A-REI.9																						
A-REI.10																						
A-REI.11																						
A-REI.12																						
8.F.1																						
8.F.2																						
8.F.3																						
8.F.4																						
8.F.5																						
F-IF.1																						
F-IF.2																						
F-IF.3																						
F-IF.4																						
F-IF.5																						
F-IF.6																						
F-IF.7																						
F-IF.8																						
F-IF.9																						
F-BF.1																						
F-BF.2																						
F-BF.3																						
F-BF.4																						
F-BF.5																						
F-LE.1																						
F-LE.2																						
F-LE.3																						
F-LE.4																						
F-LE.5																						
8.G.6																						
8.G.7																						
8.G.8																						
G-CO.1								X														
G-CO.2								X														

~~G-CO.3~~																					
~~G-CO.4~~																					
~~G-CO.5~~																					
~~G-CO.6~~																					
~~G-CO.7~~																					
~~G-CO.8~~																					
~~G-CO.9~~																					
~~G-CO.10~~																					
~~G-CO.11~~																					
~~G-CO.12~~																					
~~G-CO.13~~																					
~~8.SP.1~~																					
~~8.SP.2~~																					
~~8.SP.3~~																					
~~8.SP.4~~																					
~~S-ID.1~~																					
~~S-ID.2~~																					
~~S-ID.3~~																					
~~S-ID.4~~																					
~~S-ID.5~~											~~X~~										
~~S-ID.6~~																					
~~S-ID.7~~																					
~~S-ID.8~~																					
~~S-ID.9~~																					
~~N-RN.1~~																					
~~N-RN.2~~																					
~~N-RN.3~~											~~X~~		~~X~~								
~~A-APR.~~																					
~~A-APR.2~~																					
~~A-APR.3~~																					
~~A-APR.4~~																					
~~A-APR.5~~																					
~~A-APR.6~~																					
~~A-APR.7~~																					
~~G-SRT.1~~																					
~~G-SRT.2~~																					
~~G-SRT.3~~																					
~~G-SRT.4~~																					
~~G-SRT.5~~																					
~~G-SRT.6~~																					
~~G-SRT.7~~																					
~~G-SRT.8~~																					
~~G-SRT.9~~																					
~~G-SRT.10~~																					
~~G-SRT.11~~																					
~~G-C.1~~																					
~~G-C.2~~																					
~~G-C.3~~																					
~~G-C.4~~																					
~~G-C.5~~																					
~~G-GPE.1~~																					
~~G-GPE.2~~																					
~~G-GPE.3~~																					
~~G-GPE.4~~																					
~~G-GPE.5~~																					
~~G-GPE.6~~																					
~~G-GPE.7~~																					
~~G-GMD.1~~																					
~~G-GMD.2~~																					
~~G-GMD.3~~																					
~~G-GMD.4~~																					
~~G-MG.1~~																					
~~G-MG.2~~																					
~~G-MG.3~~																					
~~N-CN.1~~																					

~~N-CN.2~~																					
~~N-CN.3~~																					
~~N-CN.4~~																					
~~N-CN.5~~																					
~~N-CN.6~~																					
~~N-CN.7~~																					
~~N-CN.8~~																					
~~N-CN.9~~																					
~~F-TF.1~~																					
~~F-TF.2~~																					
~~F-TF.3~~																					
~~F-TF.4~~																					
~~F-TF.5~~																					
~~F-TF.6~~																					
~~F-TF.7~~																					
~~F-TF.8~~																					
~~F-TF.9~~																					
~~S-IC.1~~																					
~~S-IC.2~~																					
~~S-IC.3~~																					
~~S-IC.4~~																					
~~S-IC.5~~																					
~~S-IC.6~~																					
~~S-CP.1~~																					
~~S-CP.2~~																					
~~S-CP.3~~																					
~~S-CP.4~~																					
~~S-CP.5~~																					
~~S-CP.6~~																					
~~S-CP.7~~																					
~~S-CP.8~~																					
~~S-CP.9~~																					
~~N-VM.1~~																					
~~N-VM.2~~																					
~~N-VM.3~~																					
~~N-VM.4~~																					
~~N-VM.5~~																					
~~N-VM.6~~																					
~~N-VM.7~~																					
~~N-VM.8~~																					
~~N-VM.9~~																					
~~N-VM.10~~																					
~~N-VM.11~~																					
~~N-VM.12~~																					
~~S-MD.1~~																					
~~S-MD.2~~																					
~~S-MD.3~~																					
~~S-MD.4~~																					
~~S-MD.5~~																					
~~S-MD.6~~																					
~~S-MD.7~~																					

~~Mathematics Standards~~

~~Number and Quantity~~

~~Reason quantitatively and use unites to solve problems~~

~~N-Q.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.*~~

~~N-Q.2 Define appropriate quantities for the purpose of descriptive modeling.*~~

~~N-Q.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.*~~

Algebra

Analyze and solve linear equations and pairs of simultaneous linear equations

8.EE.8 Analyze and solve pairs of simultaneous linear equations.

a. Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously.

b. Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. For example, $3x + 2y = 5$ and $3x + 2y = 6$ have no solution because $3x + 2y$ cannot simultaneously be 5 and 6.

c. Solve real-world and mathematical problems leading to two linear equations in two variables. For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.

Interpret the structure of expressions

A-SSE.1 Interpret expressions that represent a quantity in terms of its context.*

a. Interpret parts of an expression, such as terms, factors, and coefficients.

b. Interpret complicated expressions by viewing one or more of their parts as a single entity. For example, interpret $P(1+r)n$ as the product of P and a factor not depending on P.

A-SSE.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.*

c. Use the properties of exponents to transform expressions for exponential functions. For example the expression $1.15t$ can be rewritten as $[1.151/12]\ 12t \approx 1.01212t$ to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.

Creating equations that describe numbers or relationships

A-CED.1 Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.*

A-CED.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.*

A-CED.3 Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.*

A-CED.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law $V = IR$ to highlight resistance R.*

Solve equations and inequalities in one variable

A-REI.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

Solve systems of equations

A-REI.5 Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.

A-REI.6 Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.

Represent and solve equations and inequalities graphically

A-REI.10 Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).

A-REI.11 Explain why the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.*

A-REI.12 Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

Functions

Define, evaluate, and compare functions

8.F.1 Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output. 1

8.F.2 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.

8.F.3 Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. For example, the function A = s2 giving the area of a square as a function of its side length is not linear because its graph contains the points (1,1), (2,4) and (3,9), which are not on a straight line.

Use functions to model relationships between quantities

8.F.4 Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.

8.F.5 Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.

Understand the concept of a function and use function notation

F-IF.1 Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x).

F-IF.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.

F-IF.3 Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. For example, the Fibonacci sequence is defined recursively by f(0) = f(1) = 1, f(n+1) = f(n) + f(n-1) for n ≥ 1.

Interpret functions that arise in applications in terms of the context

F-IF.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*

F-IF.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.*

F-IF.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.* Analyze functions using different representations Supporting

F-IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.* a. Graph linear and quadratic functions and show intercepts, maxima, and minima.

F-IF.9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.

Build a function that models a relationship between two quantities

F-BF.1 Write a function that describes a relationship between two quantities.* a. Determine an explicit expression, a recursive process, or steps for calculation from a context.

F-BF.2 Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.*

Construct and compare linear, quadratic, and exponential models and solve problems

F-LE.1 Distinguish between situations that can be modeled with linear functions and with exponential functions.*

a. Prove that linear functions grow by equal differences over equal intervals and that exponential functions grow by equal factors over equal intervals.

b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.

c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.

F-LE.2 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).*

F-LE.3 Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.* Interpret expressions for functions in terms of the situation they model Supporting

F-LE.5 Interpret the parameters in a linear or exponential function in terms of a context.*

Geometry

Understand and apply the Pythagorean Theorem

8.G.6 Explain a proof of the Pythagorean Theorem and its converse.

8.G.7 Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.

8.G.8 Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.

Experiment with transformations in the plane

G-CO.1 Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.

G-CO.2 Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch).

G-CO.3 Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.

G-CO.4 Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.

G-CO.5 Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.

Understand congruence in terms of rigid motions

G-CO.6 Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.

G-CO.7 Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.

G-CO.8 Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.

Prove geometric theorems

G-CO.9 Prove theorems about lines and angles. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.

G-CO.10 Prove theorems about triangles. Theorems include: measures of interior angles of a triangle sum to 180; base angles of isosceles triangles are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.

G-CO.11 Prove theorems about parallelograms. Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals.

Statistics and Probability

Investigate patterns of association in bivariate data

8.SP.1 Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.

8.SP.2 Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line.

8.SP.3 Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. For example, in a linear model for a biology experiment, interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height.

8.SP.4 Understand that patterns of association can also be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table. Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between the two variables. For example, collect data from students in your class on whether or not they have a curfew on school nights and whether or not they have assigned chores at home. Is there evidence that those who have a curfew also tend to have chores?

Summarize, represent, and interpret data on a single count or measurement variable

S-ID.1 Represent data with plots on the real number line (dot plots, histograms, and box plots).*

S-ID.2 Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.*

S-ID.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).*

Summarize, represent, and interpret data on two categorical and quantitative variables

S-ID.5 Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.*

S-ID.6 Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.*

a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models.

c. Fit a linear function for a scatter plot that suggests a linear association.

Interpret linear models

S-ID.7 Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.*

S-ID.8 Compute (using technology) and interpret the correlation coefficient of a linear fit.*

S-ID.9 Distinguish between correlation and causation.*

Algebra I

Number and Quantity

Use properties of rational and irrational numbers

N-RN.3 Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.

Reason quantitatively and use units to solve problems

N-Q.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.*

N-Q.2 Define appropriate quantities for the purpose of descriptive modeling.*
N-Q.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.*

Algebra

Interpret the structure of expressions

A-SSE.1 Interpret expressions that represent a quantity in terms of its context.*
a. Interpret parts of an expression, such as terms, factors, and coefficients.
b. Interpret complicated expressions by viewing one or more of their parts as a single entity. For example, interpret P(1+r)n as the product of P and a factor not depending on P.
A-SSE.2 Use the structure of an expression to identify ways to rewrite it. For example, see x4 − y 4 as (x2) 2 − (y2) 2 thus recognizing it as a difference of squares that can be factored as (x2 − y 2) (x2 + y2).

Write expressions in equivalent forms to solve problems

A-SSE.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.*
a. Factor a quadratic expression to reveal the zeros of the function it defines.
b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.
c. Use the properties of exponents to transform expressions for exponential functions. For example the expression 1.15t can be rewritten as [1.151/12] 12t ≈ 1.01212t to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.

Algebra I

Perform arithmetic operations on polynomials

A-APR.1 Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.

Understand the relationship between zeros and factors of polynomials

A-APR.3 Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.

Create equations that describe numbers or relationships

A-CED.1 Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.*
A-CED.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.*
A-CED.3 Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.*
A-CED.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law V = IR to highlight resistance R.*

Understand solving equations as a process of reasoning and explain the reasoning

A-REI.1 Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.

Solve equations and inequalities in one variable

A-REI.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
A-REI.4 Solve quadratic equations in one variable.
a. Use the method of completing the square to transform any quadratic equation in x into an equation of the form (x − p) 2 = q that has the same solutions. Derive the quadratic formula from this form.

b. Solve quadratic equations by inspection (e.g., for x 2 − 49), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as a ± bi for real numbers a and b.

Algebra I

Solve systems of equations

A-REI.5 Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.

A-REI.6 Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.

Represent and solve equations and inequalities graphically

A-REI.10 Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).

A-REI.11 Explain why the x-coordinates of the points where the graphs of the equations y = f(x) and y = g(x) intersect are the solutions of the equation f(x) = g(x); find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where f(x) and/or g(x) are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.*

A-REI.12 Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

Functions

Understand the concept of a function and use function notation

F-IF.1 Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x).

F-IF.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.

F-IF.3 Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. For example, the Fibonacci sequence is defined recursively by f(0) = f(1) = 1, f(n+1) = f(n) + f(n-1) for n ≥ 1

Interpret functions that arise in applications in terms of the context

F-IF.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*

F-IF.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.*

F-IF.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.*

Algebra I

Analyze functions using different representations

F-IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.*

a. Graph linear and quadratic functions and show intercepts, maxima, and minima.

b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.

F-IF.8 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.

a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.
F-IF.9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum. B

Build a function that models a relationship between two quantities

F-BF.1 Write a function that describes a relationship between two quantities.*
a. Determine an explicit expression, a recursive process, or steps for calculation from a context.

Build new functions from existing functions

F-BF.3 Identify the effect on the graph of replacing f(x) by f(x) + k, k f(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them

Construct and compare linear, quadratic, and exponential models and solve problems

F-LE.1 Distinguish between situations that can be modeled with linear functions and with exponential functions.*
a. Prove that linear functions grow by equal differences over equal intervals and that exponential functions grow by equal factors over equal intervals.
b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.
c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.
F-LE.2 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).*
F-LE.3 Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.*

Algebra I

Interpret expressions for functions in terms of the situation they model

F-LE.5 Interpret the parameters in a linear or exponential function in terms of a context.*

Statistics and Probability *

Summarize, represent, and interpret data on a single count or measurement variable

S-ID.1 Represent data with plots on the real number line (dot plots, histograms, and box plots).*
S-ID.2 Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.*
S-ID.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).*

Summarize, represent, and interpret data on two categorical and quantitative variables

S-ID.5 Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.*
S-ID.6 Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.*
a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models.
b. Informally assess the fit of a function by plotting and analyzing residuals.
c. Fit a linear function for a scatter plot that suggests a linear association.

Interpret linear models

S-ID.7 Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.*

S-ID.8 Compute (using technology) and interpret the correlation coefficient of a linear fit.*
S-ID.9 Distinguish between correlation and causation.*

Geometry Course
Geometry
Experiment with transformations in the plane

G-CO.1 Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.
G-CO.2 Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch).
G-CO.3 Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.
G-CO.4 Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.
G-CO.5 Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.

Understand congruence in terms of rigid motions

G-CO.6 Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.
G-CO.7 Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.
G-CO.8 Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.

Prove geometric theorems

G-CO.9 Prove theorems about lines and angles. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.
G-CO.10 Prove theorems about triangles. Theorems include: measures of interior angles of a triangle sum to 180; base angles of isosceles triangles are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.
G-CO.11 Prove theorems about parallelograms. Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals.

Geometry Course
Make geometric constructions

G-CO.12 Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.
G-CO.13 Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.

Understand similarity in terms of similarity transformations

G-SRT.1 Verify experimentally the properties of dilations given by a center and a scale factor:
a. A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged.
b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.

G-SRT.2 Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.
G-SRT.3 Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.

Prove theorems involving similarity

G-SRT.4 Prove theorems about triangles. Theorems include: a line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity.
G-SRT.5 Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.

Define trigonometric ratios and solve problems involving right triangles

G-SRT.6 Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.
G-SRT.7 Explain and use the relationship between the sine and cosine of complementary angles.
G-SRT.8 Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.*

Understand and apply theorems about circles

G-C.1 Prove that all circles are similar
G-C.2 Identify and describe relationships among inscribed angles, radii, and chords. Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.
G-C.3 Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.

Find arc lengths and areas of sectors of circles

G-C.5 Derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector.

Translate between the geometric description and the equation for a conic section A

G-GPE.1 Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.

Use coordinates to prove simple geometric theorems algebraically

G-GPE.4 Use coordinates to prove simple geometric theorems algebraically. For example, prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle; prove or disprove that the point $(1, \sqrt{3})$ lies on the circle centered at the origin and containing the point (0, 2).
G-GPE.5 Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).
G-GPE.6 Find the point on a directed line segment between two given points that partitions the segment in a given ratio.
G-GPE.7 Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.*

Explain volume formulas and use them to solve problems

G-GMD.1 Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. Use dissection arguments, Cavalieri's principle, and informal limit arguments.
G-GMD.3 Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.*

Visualize relationships between two-dimensional and three-dimensional objects

G-GMD.4 Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.

Apply geometric concepts in modeling situations

G-MG.1 Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).*

G-MG.2 Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).*

G-MG.3 Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).*

Algebra II

Number and Quantity

Extend the properties of exponents to rational exponents

N-RN.1 Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. For example, we define 51/3 to be the cube root of 5 because we want [51/3] 3 = 5(1/3) 3 to hold, so [51/3] 3 must equal 5.

N-RN.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents.

Reason quantitatively and use units to solve problems

N-Q.2 Define appropriate quantities for the purpose of descriptive modeling.*

Perform arithmetic operations with complex numbers

N-CN.1 Know there is a complex number i such that i 2 = −1, and every complex number has the form a + bi with a and b real.

N-CN.2 Use the relation i 2 = −1 and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.

Use complex numbers in polynomial identities and equations

N-CN.7 Solve quadratic equations with real coefficients that have complex solutions.

Algebra

Interpret the structure of expressions

A-SSE.2 Use the structure of an expression to identify ways to rewrite it. For example, see x4 − y 4 as (x2) 2 − (y2) 2, thus recognizing it as a difference of squares that can be factored as (x2 − y 2) (x2 + y2).

Write expressions in equivalent forms to solve problems

A-SSE.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.* c. Use the properties of exponents to transform expressions for exponential functions. For example the expression 1.15t can be rewritten as [1.151/12] 12t ≈ 1.01212t to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.

Algebra II

A-SSE.4 Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. For example, calculate mortgage payments.*

Understand the relationship between zeros and factors of polynomials

A-APR.2 Know and apply the Remainder Theorem: For a polynomial p(x) and a number a, the remainder on division by x − a is p(a), so p(a) = 0 if and only if (x − a) is a factor of p(x).

A-APR.3 Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.

Use polynomial identities to solve problems

A-APR.4 Prove polynomial identities and use them to describe numerical relationships. For example, the polynomial identity (x2 + y2) 2 = (x2 − y 2) 2 + (2xy) 2 can be used to generate Pythagorean triples.

Rewrite rational expressions

A-APR.6 Rewrite simple rational expressions in different forms; write a(x)/b(x) in the form q(x) + r(x)/b(x), where a(x), b(x), q(x), and r(x) are polynomials with the degree of r(x) less than the degree of b(x), using inspection, long division, or, for the more complicated examples, a computer algebra system.

Create equations that describe numbers or relationships

A-CED.1 Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.*

Understand solving equations as a process of reasoning and explain the reasoning

A-REI.1 Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.

A-REI.2 Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.

Solve equations and inequalities in one variable

A-REI.4 Solve quadratic equations in one variable. b. Solve quadratic equations by inspection (e.g., for x 2 = 49), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as a ± bi for real numbers a and b.

Algebra II

Solve systems of equations

A-REI.6 Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.

A-REI.7 Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. For example, find the points of intersection between the line y = −3x and the circle x2 + y2 = 3.

Represent and solve equations and inequalities graphically

A-REI.11 Explain why the x-coordinates of the points where the graphs of the equations y = f(x) and y = g(x) intersect are the solutions of the equation f(x) = g(x); find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where f(x) and/or g(x) are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.*

Functions

Understand the concept of a function and use function notation

F-IF.3 Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. For example, the Fibonacci sequence is defined recursively by f(0) = f(1) = 1, f(n+1) = f(n) + f(n-1) for n ≥ 1.

Interpret functions that arise in applications in terms of the context

F-IF.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*

F-IF.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.*

Analyze functions using different representations

F-IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.*

c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.

e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.

Algebra II

F-IF.8 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.

b. Use the properties of exponents to interpret expressions for exponential functions. For example, identify percent rate of change in functions such as $y = (1.02)t$, $y = (0.97)t$, $y = (1.01)12t$, $y = (1.2)t/10$, and classify them as representing exponential growth and decay.

F-IF.9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.

Build a function that models a relationship between two quantities

F-BF.1 Write a function that describes a relationship between two quantities.*

a. Determine an explicit expression, a recursive process, or steps for calculation from a context.

b. Combine standard function types using arithmetic operations. For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.

F-BF.2 Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.*

Build new functions from existing functions

F-BF.3 Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k\,f(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.

F-BF.4 Find inverse functions. a. Solve an equation of the form $f(x) = c$ for a simple function f that has an inverse and write an expression for the inverse. For example, $f(x) = 2x^3$ or $f(x) = (x+1)/(x-1)$ for $x \neq 1$.

Construct and compare linear, quadratic, and exponential models and solve problems

F-LE.2 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).*

F-LE.4 For exponential models, express as a logarithm the solution to $abct = d$ where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology.*

Interpret expressions for functions in terms of the situation they model

F-LE.5 Interpret the parameters in a linear or exponential function in terms of a context.*

Algebra II

Extend the domain of trigonometric functions using the unit circle

F-TF.1 Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.

F-TF.2 Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle.

Model periodic phenomena with trigonometric functions

F-TF.5 Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.*

Prove and apply trigonometric identities

F-TF.8 Prove the Pythagorean identity $\sin(\Theta)^2 + \cos(\Theta)^2 = 1$ and use it to find $\sin(\Theta)$, $\cos(\Theta)$, or $\tan(\Theta)$, given $\sin(\Theta)$, $\cos(\Theta)$, or $\tan(\Theta)$ and the quadrant of the angle.

Geometry

Translate between the geometric description and the equation for a conic section

G-GPE.2 Derive the equation of a parabola given a focus and directrix.

Statistics and Probability

Summarize, represent, and interpret data on a single count or measurement variable

S-ID.4 Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.*

Summarize, represent, and interpret data on two categorical and quantitative variables

S-ID.6 Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.*

a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models.

Algebra II

Understand and evaluate random processes underlying statistical experiments

S-IC.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population.*

S-IC.2 Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?*

Make inferences and justify conclusions from sample surveys, experiments, and observational studies

S-IC.3 Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.*

S-IC.4 Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.*

S-IC.5 Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.*

S-IC.6 Evaluate reports based on data.*

Understand independence and conditional probability and use them to interpret data

S-CP.1 Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events ("or," "and," "not").*

S-CP.2 Understand that two events A and B are independent if the probability of A and B occurring together is the product of their probabilities, and use this characterization to determine if they are independent.*

S-CP.3 Understand the conditional probability of A given B as P(A and B)/P(B), and interpret independence of A and B as saying that the conditional probability of A given B is the same as the probability of A, and the conditional probability of B given A is the same as the probability of B.*

S-CP.4 Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities. For example, collect data from a random sample of students in your school on their favorite subject among math, science, and English. Estimate the probability that a randomly selected student from your school will favor science given that the student is in tenth grade. Do the same for other subjects and compare the results.*

S-CP.5 Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. For example, compare the chance of having lung cancer if you are a smoker with the chance of being a smoker if you have lung cancer.*

Use the rules of probability to compute probabilities of compound events in a uniform probability model

S-CP.6 Find the conditional probability of A given B as the fraction of B's outcomes that also belong to A, and interpret the answer in terms of the model.*

S-CP.7 Apply the Addition Rule, P(A or B) = P(A) + P(B) – P(A and B), and interpret the answer in terms of the model.*

Integrated Mathematics
Number and Quantity
Reason quantitatively and use units to solve problems

N-Q.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.*
N-Q.2 Define appropriate quantities for the purpose of descriptive modeling.*
N-Q.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.*

Algebra
Interpret the structure of expressions

A-SSE.1 Interpret expressions that represent a quantity in terms of its context.*
a. Interpret parts of an expression, such as terms, factors, and coefficients.
b. Interpret complicated expressions by viewing one or more of their parts as a single entity. For example, interpret P(1+r)n as the product of P and a factor not depending on P.

Write expressions in equivalent forms to solve problems

A-SSE.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.*
c. Use the properties of exponents to transform expressions for exponential functions. For example the expression 1.15t can be rewritten as [1.151/12] 12t ≈ 1.01212t to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.

Create equations that describe numbers or relationships

A-CED.1 Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.*
A-CED.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.*
A-CED.3 Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.*
A-CED.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law V = IR to highlight resistance R.*

Integrated Mathematics I
Solve equations and inequalities in one variable

A-REI.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

Solve systems of equations

A-REI.5 Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.
A-REI.6 Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.

Represent and solve equations and inequalities graphically

A-REI.10 Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).
A-REI.11 Explain why the x-coordinates of the points where the graphs of the equations y = f(x) and y = g(x) intersect are the solutions of the equation f(x) = g(x); find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where f(x) and/or g(x) are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.*

A-REI.12 Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

Functions

Understand the concept of a function and use function notation

F-IF.1 Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x).

F-IF.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.

F-IF.3 Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. For example, the Fibonacci sequence is defined recursively by $f(0) = f(1) = 1$, $f(n+1) = f(n) + f(n-1)$ for $n \geq 1$.

Interpret functions that arise in applications in terms of the context

F-IF.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*

Integrated Mathematics I

F-IF.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.*

F-IF.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.*

Analyze functions using different representations

F-IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.*

a. Graph linear and quadratic functions and show intercepts, maxima, and minima.

F-IF.9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.

Build a function that models a relationship between two quantities

F-BF.1 Write a function that describes a relationship between two quantities.* a. Determine an explicit expression, a recursive process, or steps for calculation from a context.

F-BF.2 Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.*

Construct and compare linear, quadratic, and exponential models and solve problems

F-LE.1 Distinguish between situations that can be modeled with linear functions and with exponential functions.*

a. Prove that linear functions grow by equal differences over equal intervals and that exponential functions grow by equal factors over equal intervals.

b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.

c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.

F-LE.2 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).*

F-LE.3 Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.*

Interpret expressions for functions in terms of the situation they model

F-LE.5 Interpret the parameters in a linear or exponential function in terms of a context.*

Integrated Mathematics I

Geometry

Experiment with transformations in the plane

G-CO.1 Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.

G-CO.2 Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch).

G-CO.3 Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.

G-CO.4 Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.

G-CO.5 Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.

Understand congruence in terms of rigid motions

G-CO.6 Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.

G-CO.7 Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.

G-CO.8 Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.

Prove geometric theorems

G-CO.9 Prove theorems about lines and angles. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.

G-CO.10 Prove theorems about triangles. Theorems include: measures of interior angles of a triangle sum to 180; base angles of isosceles triangles are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.

G-CO.11 Prove theorems about parallelograms. Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals.

Integrated Mathematics I

Statistics and Probability

Summarize, represent, and interpret data on a single count or measurement variable

S-ID.1 Represent data with plots on the real number line (dot plots, histograms, and box plots).*

S-ID.2 Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.*

S-ID.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).*

Summarize, represent, and interpret data on two categorical and quantitative variables

S-ID.5 Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.*

S-ID.6 Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.*

a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models.
c. Fit a linear function for a scatter plot that suggests a linear association.

Interpret linear models

S-ID.7 Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.*
S-ID.8 Compute (using technology) and interpret the correlation coefficient of a linear fit.*
S-ID.9 Distinguish between correlation and causation.*

Integrated Mathematics I

Number and Quantity

Extend the properties of exponents to rational exponents

N-RN.1 Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. For example, we define 51/3 to be the cube root of 5 because we want [51/3] 3 = 5(1/3) 3 to hold, so [51/3] 3 must equal 5.
N-RN.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents.

Use properties of rational and irrational numbers

N-RN.3 Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.

Reason quantitatively and use units to solve problems

N-Q.2 Define appropriate quantities for the purpose of descriptive modeling.*

Perform arithmetic operations with complex numbers

N-CN.1 Know there is a complex number i such that i 2 = −1, and every complex number has the form a + bi with a and b real.
N-CN.2 Use the relation i 2 = −1 and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.

Use complex numbers in polynomial identities and equations

N-CN.7 Solve quadratic equations with real coefficients that have complex solutions.

Algebra

Interpret the structure of expressions

A-SSE.1 Interpret expressions that represent a quantity in terms of its context.* b. Interpret complicated expressions by viewing one or more of their parts as a single entity. For example, interpret P(1+r)n as the product of P and a factor not depending on P.

Integrated Mathematics II

A-SSE.2 Use the structure of an expression to identify ways to rewrite it. For example, see x4 − y 4 as (x2) 2 − (y2) 2, thus recognizing it as a difference of squares that can be factored as (x2 − y 2) (x2 + y2).

Write expressions in equivalent forms to solve problems

A-SSE.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.*
a. Factor a quadratic expression to reveal the zeros of the function it defines.
b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.

Perform arithmetic operations on polynomials

A-APR.1 Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.

Create equations that describe numbers or relationships

A-CED.1 Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.*

A-CED.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.*

A-CED.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law V = IR to highlight resistance R.*

Understand solving equations as a process of reasoning and explain the reasoning M

A-REI.1 Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.

Solve equations and inequalities in one variable

A-REI.4 Solve quadratic equations in one variable.

a. Use the method of completing the square to transform any quadratic equation in x into an equation of the form (x − p) 2 = q that has the same solutions. Derive the quadratic formula from this form.

b. Solve quadratic equations by inspection (e.g., for x 2 = 49), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as a ± bi for real numbers a and b.

Solve systems of equations

A-REI.7 Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. For example, find the points of intersection between the line y = −3x and the circle x2 + y2 = 3.

Functions

Interpret functions that arise in applications in terms of the context M

F-IF.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*

F-IF.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.*

F-IF.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.*

Analyze functions using different representations

F-IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.*

a. Graph linear and quadratic functions and show intercepts, maxima, and minima.

b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.

e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.

F-IF.8 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.

a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.

b. Use the properties of exponents to interpret expressions for exponential functions. For example, identify percent rate of change in functions such as y = (1.02)t , y = (0.97)t , y = (1.01)12t, y = (1.2)t/10, and classify them as representing exponential growth and decay.

F-IF.9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.

Integrated Mathematics II

Build a function that models a relationship between two quantities

F-BF.1 Write a function that describes a relationship between two quantities.*

a. Determine an explicit expression, a recursive process, or steps for calculation from a context.

b. Combine standard function types using arithmetic operations. For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.

Build new functions from existing functions

F-BF.3 Identify the effect on the graph of replacing f(x) by f(x) + k, k f(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.

Geometry

Understand similarity in terms of similarity transformations

G-SRT.1 Verify experimentally the properties of dilations given by a center and a scale factor:

a. A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged.

b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.

G-SRT.2 Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.

G-SRT.3 Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.

Prove theorems using similarity

G-SRT.4 Prove theorems about triangles. Theorems include: a line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity.

G-SRT.5 Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.

Define trigonometric ratios and solve problems involving right triangles

G-SRT.6 Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.

G-SRT.7 Explain and use the relationship between the sine and cosine of complementary angles.

Integrated Mathematics II

G-SRT.8 Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.*

Explain volume formulas and use them to solve problems

G-GMD.1 Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. Use dissection arguments, Cavalieri's principle, and informal limit arguments.

G-GMD.3 Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.*

Statistics and Probability*

Summarize, represent, and interpret data on two categorical and quantitative variables

S-ID.6 Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.*

a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models.
b. Informally assess the fit of a function by plotting and analyzing residuals.

Understand independence and conditional probability and use them to interpret data

S-CP.1 Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events ("or," "and," "not").*

S-CP.2 Understand that two events A and B are independent if the probability of A and B occurring together is the product of their probabilities, and use this characterization to determine if they are independent.*

S-CP.3 Understand the conditional probability of A given B as P(A and B)/P(B), and interpret independence of A and B as saying that the conditional probability of A given B is the same as the probability of A, and the conditional probability of B given A is the same as the probability of B.*

S-CP.4 Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities. For example, collect data from a random sample of students in your school on their favorite subject among math, science, and English. Estimate the probability that a randomly selected student from your school will favor science given that the student is in tenth grade. Do the same for other subjects and compare the results.*

S-CP.5 Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. For example, compare the chance of having lung cancer if you are a smoker with the chance of being a smoker if you have lung cancer.

Integrated Mathematics II

Use the rules of probability to compute probabilities of compound events in a uniform probability model

S-CP.6 Find the conditional probability of A given B as the fraction of B's outcomes that also belong to A, and interpret the answer in terms of the model.*

S-CP.7 Apply the Addition Rule, P(A or B) = P(A) + P(B) − P(A and B), and interpret the answer in terms of the model.*

Integrated Mathematics III

Number and Quantity

Reason quantitatively and use units to solve problems

N-Q.2 Define appropriate quantities for the purpose of descriptive modeling.*

Algebra

Interpret the structure of expressions

A-SSE.2 Use the structure of an expression to identify ways to rewrite it. For example, see $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$.

Write expressions in equivalent forms to solve problems

A-SSE.4 Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. For example, calculate mortgage payments.*

Understand the relationship between zeros and factors of polynomials

A-APR.2 Know and apply the Remainder Theorem: For a polynomial p(x) and a number a, the remainder on division by x − a is p(a), so p(a) = 0 if and only if (x − a) is a factor of p(x).

A-APR.3 Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.

Use polynomial identities to solve problems

A-APR.4 Prove polynomial identities and use them to describe numerical relationships. For example, the polynomial identity $(x^2 + y^2)^2 = (x^2 - y^2)^2 + (2xy)^2$ can be used to generate Pythagorean triples.

~~Rewrite rational expressions~~

~~A-APR.6 Rewrite simple rational expressions in different forms; write a(x)/b(x) in the form q(x) + r(x)/b(x), where a(x), b(x), q(x), and r(x) are polynomials with the degree of r(x) less than the degree of b(x), using inspection, long division, or, for the more complicated examples, a computer algebra system.~~

~~Integrated Mathematics III~~

~~Create equations that describe numbers or relationships~~

~~A-CED.1 Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.*~~

~~A-CED.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.*~~

~~Understand solving equations as a process of reasoning and explain the reasoning~~

~~A-REI.1 Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.~~

~~A-REI.2 Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.~~

~~Represent and solve equations and inequalities graphically~~

~~A-REI.11 Explain why the x-coordinates of the points where the graphs of the equations y = f(x) and y = g(x) intersect are the solutions of the equation f(x) = g(x); find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where f(x) and/or g(x) are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.*~~

~~Interpret functions that arise in applications in terms of the context~~

~~F-IF.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*~~

~~F-IF.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.*~~

~~Analyze functions using different representations~~

~~F-IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.* c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.~~

~~F-IF.9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.~~

~~Build new functions from existing functions~~

~~F-BF.3 Identify the effect on the graph of replacing f(x) by f(x) + k, k f(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.~~

~~F-BF.4 Find inverse functions. a. Solve an equation of the form f(x) = c for a simple function f that has an inverse and write an expression for the inverse. For example, f(x) =2x3 or f(x) = (x+1)/(x-1) for x ≠ 1.~~

~~Construct and compare linear, quadratic, and exponential models and solve problems~~

~~F-LE.4 For exponential models, express as a logarithm the solution to abct = d where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology.*~~

Extend the domain of trigonometric functions using the unit circle

F-TF.1 Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.

F-TF.2 Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle.

Model periodic phenomena with trigonometric functions

F-TF.5 Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.*

Prove and apply trigonometric identities

F-TF.8 Prove the Pythagorean identity $\sin(\Theta)^2 + \cos(\Theta)^2 = 1$ and use it to find $\sin(\Theta)$, $\cos(\Theta)$, or $\tan(\Theta)$, given $\sin(\Theta)$, $\cos(\Theta)$, or $\tan(\Theta)$ and the quadrant of the angle.

Integrated Mathematics III

Geometry

Make geometric constructions

G-CO.12 Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.

G-CO.13 Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.

Understand and apply theorems about circles

G-C.1 Prove that all circles are similar.

G-C.2 Identify and describe relationships among inscribed angles, radii, and chords. Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.

G-C.3 Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.

Find arc lengths and areas of sectors of circles

G-C.5 Derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector.

Translate between the geometric description and the equation for a conic section

G-GPE.1 Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.

G-GPE.2 Derive the equation of a parabola given a focus and directrix.

Use coordinates to prove simple geometric theorems algebraically

G-GPE.4 Use coordinates to prove simple geometric theorems algebraically. For example, prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle; prove or disprove that the point $(1, \sqrt{3})$ lies on the circle centered at the origin and containing the point $(0, 2)$.

G-GPE.5 Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).

Integrated Mathematics III

G-GPE.6 Find the point on a directed line segment between two given points that partitions the segment in a given ratio.

G-GPE.7 Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.*

Visualize relationships between two-dimensional and three-dimensional objects

G-GMD.4 Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.

Apply geometric concepts in modeling situations

G-MG.1 Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).*

G-MG.2 Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).*

G-MG.3 Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).*

Statistics and Probability*

Summarize, represent, and interpret data on a single count or measurement variable S

S-ID.4 Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.*

Summarize, represent, and interpret data on two categorical and quantitative variables

S-ID.6 Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.*

a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models.

b. Informally assess the fit of a function by plotting and analyzing residuals.

Understand and evaluate random processes underlying statistical experiments

S-IC.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population.

Integrated Mathematics III

S-IC.2 Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?*

Make inferences and justify conclusions from sample surveys, experiments, and observational studies

S-IC.3 Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.*

S-IC.4 Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.*

S-IC.5 Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.*

S-IC.6 Evaluate reports based on data.*

Advanced Mathematics Plus

Number and Quantity

Perform arithmetic operations with complex numbers

N-CN.3 Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers.

Represent complex numbers and their operations on the complex plane

N-CN.4 Represent complex numbers on the complex plane in rectangular and polar form (including real and imaginary numbers), and explain why the rectangular and polar forms of a given complex number represent the same number.

N-CN.5 Represent addition, subtraction, multiplication, and conjugation of complex numbers geometrically on the complex plane; use properties of this representation for computation. For example, $(-1 + \sqrt{3}\, i)^3 = 8$ because $(-1 + \sqrt{3}\, i)$ has modulus 2 and argument 120°.

N-CN.6 Calculate the distance between numbers in the complex plane as the modulus of the difference, and the midpoint of a segment as the average of the numbers at its endpoints.

Use complex numbers in polynomial identities and equations

N-CN.8 Extend polynomial identities to the complex numbers. For example, rewrite $x^2 + 4$ as $(x + 2i)(x - 2i)$.

N-CN.9 Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials

Represent and model with vector quantities

N-VM.1 Recognize vector quantities as having both magnitude and direction. Represent vector quantities by directed line segments, and use appropriate symbols for vectors and their magnitudes (e.g., v, |v|, ||v||, v).

N-VM.2 Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point.

N-VM.3 Solve problems involving velocity and other quantities that can be represented by vectors.

Advanced Mathematics Plus

Perform operations on vectors

N-VM.4 Add and subtract vectors.

a. Add vectors end-to-end, component-wise, and by the parallelogram rule. Understand that the magnitude of a sum of two vectors is typically not the sum of the magnitudes.

b. Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum.

c. Understand vector subtraction $v - w$ as $v + (-w)$, where $-w$ is the additive inverse of w, with the same magnitude as w and pointing in the opposite direction. Represent vector subtraction graphically by connecting the tips in the appropriate order, and perform vector subtraction component-wise.

N-VM.5 Multiply a vector by a scalar.

a. Represent scalar multiplication graphically by scaling vectors and possibly reversing their direction; perform scalar multiplication component-wise, e.g., as $c(vx, vy) = (cvx, cvy)$.

b. Compute the magnitude of a scalar multiple cv using $||cv|| = |c|v$. Compute the direction of cv knowing that when $|c|v \neq 0$, the direction of cv is either along v (for $c > 0$) or against v (for $c < 0$).

Perform operations on matrices and use matrices in applications

N-VM.6 Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network.

N-VM.7 Multiply matrices by scalars to produce new matrices, e.g., as when all of the payoffs in a game are doubled.

N-VM.8 Add, subtract, and multiply matrices of appropriate dimensions.

N-VM.9 Understand that, unlike multiplication of numbers, matrix multiplication for square matrices is not a commutative operation, but still satisfies the associative and distributive properties.

N-VM.10 Understand that the zero and identity matrices play a role in matrix addition and multiplication similar to the role of 0 and 1 in the real numbers. The determinant of a square matrix is nonzero if and only if the matrix has a multiplicative inverse.

N-VM.11 Multiply a vector (regarded as a matrix with one column) by a matrix of suitable dimensions to produce another vector. Work with matrices as transformations of vectors.

N-VM.12 Work with 2×2 matrices as transformations of the plane, and interpret the absolute value of the determinant in terms of area.

Algebra

Use polynomial identities to solve problems

A-APR.5 Know and apply the Binomial Theorem for the expansion of (x + y) n in powers of x and y for a positive integer n, where x and y are any numbers, with coefficients determined for example by Pascal's Triangle.

Advanced Mathematics Plus

Rewrite rational expressions

A-APR.7 Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions.

Solve systems of equations

A-REI.8 Represent a system of linear equations as a single matrix equation in a vector variable.

A-REI.9 Find the inverse of a matrix if it exists and use it to solve systems of linear equations (using technology for matrices of dimension 3 × 3 or greater).

Functions

Analyze functions using different representations

F-IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.*

d. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.

Build a function that models a relationship between two quantities

F-BF.1 Write a function that describes a relationship between two quantities. *

c. Compose functions. For example, if T(y) is the temperature in the atmosphere as a function of height, and h(t) is the height of a weather balloon as a function of time, then T(h(t)) is the temperature at the location of the weather balloon as a function of time.

Build new functions from existing functions

F-BF.4 Find inverse functions.

b. Verify by composition that one function is the inverse of another.

c. Read values of an inverse function from a graph or a table, given that the function has an inverse.

d. Produce an invertible function from a non-invertible function by restricting the domain.

F-BF.5 Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.

Advanced Mathematics Plus

Extend the domain of trigonometric functions using the unit circle

F-TF.3 Use special triangles to determine geometrically the values of sine, cosine, tangent for π/3, π/4 and π/6, and use the unit circle to express the values of sine, cosine, and tangent for π − x, π+x, and 2π − x in terms of their values for x, where x is any real number.

F-TF.4 Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.

Model periodic phenomena with trigonometric functions

F-TF.6 Understand that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed.

F-TF.7 Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context. *

Prove and apply trigonometric identities

F-TF.9 Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems.

Geometry

Apply trigonometry to general triangles

G-SRT.9 Derive the formula A = ½ ab sin(C) for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side.
G-SRT.10 Prove the Laws of Sines and Cosines and use them to solve problems.
G-SRT.11 Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces).

Understand and apply theorems about circles

G-C.4 Construct a tangent line from a point outside a given circle to the circle.

Translate between the geometric description and the equation for a conic section

Advanced Mathematics Plus

G-GPE.3 Derive the equations of ellipses and hyperbolas given the foci, using the fact that the sum or difference of distances from the foci is constant.

Explain volume formulas and use them to solve problems

G-GMD.2 Give an informal argument using Cavalieri's principle for the formulas for the volume of a sphere and other solid figures.

Statistics and Probability*

Use the rules of probability to compute probabilities of compound events in a uniform probability model

S-CP.8 Apply the general Multiplication Rule in a uniform probability model, P(A and B) = P(A)P(B|A) = P(B)P(A|B), and interpret the answer in terms of the model.*
S-CP.9 Use permutations and combinations to compute probabilities of compound events and solve problems.*

Calculate expected values and use them to solve problems

S-MD.1 Define a random variable for a quantity of interest by assigning a numerical value to each event in a sample space; graph the corresponding probability distribution using the same graphical displays as for data distributions.*
S-MD.2 Calculate the expected value of a random variable; interpret it as the mean of the probability distribution.*
S-MD.3 Develop a probability distribution for a random variable defined for a sample space in which theoretical probabilities can be calculated; find the expected value. For example, find the theoretical probability distribution for the number of correct answers obtained by guessing on all five questions of a multiple-choice test where each question has four choices, and find the expected grade under various grading schemes.*
S-MD.4 Develop a probability distribution for a random variable defined for a sample space in which probabilities are assigned empirically; find the expected value. For example, find a current data distribution on the number of TV sets per household in the United States, and calculate the expected number of sets per household. How many TV sets would you expect to find in 100 randomly selected households?*

Advanced Mathematics Plus

Use probability to evaluate outcomes of decisions

S-MD.5 Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values. *
a. Find the expected payoff for a game of chance. For example, find the expected winnings from a state lottery ticket or a game at a fast-food restaurant.
b. Evaluate and compare strategies on the basis of expected values. For example, compare a high-deductible versus a low-deductible automobile insurance policy using various, but reasonable, chances of having a minor or a major accident.*
S-MD.6 Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).*
S-MD.7 Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).*

2025 Interactive Media Technology

Program CIP: 50.0411 - Game and Interactive Media Design

Direct inquiries to:

Project Manager
Research and Curriculum Unit
P.O. Drawer DX
Mississippi State, MS 39762
662.325.2510
helpdesk@rcu.msstate.edu

Program Supervisor
Office of Career and Technical Education
Mississippi Department of Education
P.O. Box 771
Jackson, MS 39205
601.359.3974

Published by:

Office of Career and Technical Education
Mississippi Department of Education
Jackson, MS 39205

Research and Curriculum Unit
Mississippi State University
Mississippi State, MS 39762

The Research and Curriculum Unit (RCU), located in Starkville, as part of Mississippi State University (MSU), was established to foster educational enhancements and innovations. In keeping with the land-grant mission of MSU, the RCU is dedicated to improving the quality of life for Mississippians. The RCU enhances intellectual and professional development of Mississippi students and educators while applying knowledge and educational research to the lives of the people of the state. The RCU works within the contexts of curriculum development and revision, research, assessment, professional development, and industrial training.

Table of Contents

Acknowledgments

The Interactive Media Technology (IMT) curriculum was presented to the Mississippi State Board of Education on date. The following persons served on the state board at the time:

Dr. Lance Evans, State Superintendent of Education, Executive Secretary
Mr. Glen East, Chair
Mr. Matt Miller, Vice-Chair
Dr. Ronnie McGehee
Mr. Bill Jacobs
Mr. Mike Pruitt
Ms. Mary Werner
Dr. Wendi Barrett
Ms. Billye Jean Stroud
Mr. Matt Mayo
Ms. Kate Riddle
Mr. Crosby Parker

The following Mississippi Department of Education (MDE) and RCU managers and specialists assisted in the development of the curriculum:

Brett Robinson, the associate state superintendent of the MDE Office of Career and Technical Education (CTE) and Workforce Development, supported the RCU and teachers throughout the development of the framework and supporting materials.
Josh Stanford, the Multimedia program supervisor of the MDE Office of CTE, supported the RCU and teachers throughout the development of the framework and supporting materials.
Betsey Smith, the director of the RCU, supported RCU staff and teachers throughout the development of this framework and supporting materials.
Courtney McCubbins, the curriculum and assessment manager of the RCU, supported RCU staff and teachers throughout the development of this framework and supporting materials.
Kyle McDill, a project manager with the RCU, researched and co-authored this framework.

Special thanks are extended to the educators who contributed to the development and revision of this framework and supporting materials:

Samuel Everett, Mississippi Gulf Coast Community College, Gulfport
Myesha Wallace, Jackson Career Center, Jackson
Leigh Watson, Greenwood-Leflore Career Center, Greenwood
Justin Gough, Pearl High School, Pearl

Appreciation is expressed to the following professionals who provided guidance and insight throughout the development process:

Vinny Jordan, Lobaki, Jackson

Standards

Standards and alignment crosswalks are referenced in the appendices. Depending on the curriculum, these crosswalks should identify alignment to the standards mentioned below, as well as possible related academic topics as required in the Subject Area Testing Program in Algebra I, Biology I, English II, and U.S. History from 1877, which could be integrated into the content of the units. Mississippi's CTE Interactive Media Technology (IMT) is aligned to the following standards:

Common Career Technical Core Standards for the Arts, Audio-Video Technology, and Communications Career Cluster

The Common Career Technical Core (CCTC) is a state-led initiative coordinated by the National Association of State Directors of Career Technical Education/National Career Technology Education Foundation (NASDCTEc/NCTEF) to establish a set of rigorous, high-quality standards for CTE that states can adopt. A diverse group of teachers, business and industry experts, administrators, and researchers helped guide the development of the CCTC from beginning to end to ensure CTE students will have the knowledge and skills to thrive in a global economy. The IMT curriculum will be aligned to the CCTC Standards for the Arts, Audio-Video Technology, and Communications Cluster. Copyright 2012. NASDCTEc/NCTEF. All rights reserved. Retrieved from careertech.org/CCTC.

College- and Career-Ready Standards

College- and career-readiness standards emphasize critical thinking, teamwork, and problem-solving skills. Students will learn the skills and abilities demanded by the workforce of today and the future. Mississippi adopted *Mississippi College and Career Ready Standards* (*MCCRS*) to provide a consistent, clear understanding of what students are expected to learn and so teachers and parents know what they need to do to help them.
mdek12.org/OAE/college-and-career-readiness-standards

International Society for Technology in Education Standards (ISTE)

Reprinted with permission from *ISTE Standards for Students* (2016). All rights reserved. Permission does not constitute an endorsement by ISTE (iste.org).

Framework for 21st Century Learning

In defining 21st century learning, the Partnership for 21st Century Skills has embraced key themes and skill areas that represent the essential knowledge for the 21st century: global awareness; financial, economic, business, and entrepreneurial literacy; civic literacy; health literacy; environmental literacy; learning and innovation skills; information, media, and technology skills; and life and career skills.
p21.org/storage/documents/docs/P21_Framework_Definitions_New_Logo_2015.pdf

Preface

Secondary CTE programs in Mississippi face many challenges resulting from sweeping educational reforms at the national and state levels. Schools and teachers are increasingly being held accountable for providing applied learning activities to every student in the classroom. This accountability is measured through increased requirements for mastery and attainment of competency as documented through both formative and summative assessments. This document provides information, tools, and solutions that will aid students, teachers, and schools in creating and implementing applied, interactive, and innovative lessons. Through best practices, alignment with national standards and certifications, community partnerships, and a hands-on, student-centered concept, educators will be able to truly engage students in meaningful and collaborative learning opportunities.

The courses in this document reflect the statutory requirements as found in Section 37-3-49, *Mississippi Code of 1972*, as amended (Section 37-3-46). In addition, this curriculum reflects guidelines imposed by federal and state mandates (Laws, 1988, Ch. 487, §14; Laws, 1991, Ch. 423, §1; Laws, 1992, Ch. 519, §4 eff. from and after July 1, 1992; Strengthening Career and Technical Education for the 21st Century Act, 2019 [Perkins V]; and Every Student Succeeds Act, 2015).

Mississippi Teacher Professional Resources

The following are resources for Mississippi teachers:

Curriculum, Assessment, Professional Learning
: Program resources can be found at the RCU's website, rcu.msstate.edu.

Learning Management System: An Online Resource
: Learning management system information can be found at the RCU's website, under Professional Learning.

Should you need additional instructions, contact the RCU at 662.325.2510 or helpdesk@rcu.msstate.edu.

Executive Summary

Pathway Description:
The Interactive Media Technology (IMT) pathway is an innovative program designed to equip students with the skills and knowledge needed to thrive in the rapidly evolving fields of game design, interactive media, and digital storytelling. This curriculum builds upon foundational principles from the Simulation and Animation Design (SAD) program and integrates advanced techniques in game development, interactive simulations, and multimedia production. The IMT pathway emphasizes hands-on, project-based learning experiences that mirror real-world industry practices, preparing students for postsecondary education and immediate entry into the workforce.

College, Career, and Certifications:
Research with industry professionals in Mississippi has informed the curriculum design, ensuring alignment with current industry standards and workforce needs. The IMT curriculum prepares students for certifications such as the Autodesk Certified Associate in 3ds Max and Unity Certified Developer. These certifications validate the skills required for careers in game design, interactive media, and related fields.

Grade Level and Class Size Recommendations:
Students are recommended to begin the IMT program in the 10th grade. To ensure an optimal learning environment, it is recommended that class sizes do not exceed 15 students per instructor, allowing for personalized instruction and ample access to technological resources.

Student Prerequisites
For students to experience success in the program, the following student prerequisites are suggested:

1. C or higher in English (the previous year)
2. C or higher in high school level math (last course taken or the instructor can specify the level of math instruction needed)
3. Instructor approval and TABE reading score (eighth grade or higher)

or

1. TABE reading and math score (eighth grade or higher)
2. Instructor approval

or

1. Instructor approval

Assessment
The latest assessment blueprint for the curriculum can be found at rcu.msstate.edu/curriculum.

Applied Academic Credit
The latest academic credit information can be found at mdek12.org/ESE/Approved-Course-for-the-Secondary-Schools.

Teacher Licensure

The latest teacher licensure information can be found at mdek12.org/oel/apply-for-an-educator-license.

Professional Learning

If you have specific questions about the content of any training sessions provided, please contact the RCU at 662.325.2510 or helpdesk@rcu.msstate.edu.

Course Outlines

Option 1—Four 1-Carnegie Unit Courses

This curriculum consists of four 1-credit courses, which should be completed in the following sequence:

1. **Foundations of Interactive Media Technology—Course Code: 994402**
2. **Interactive Media Design and Development—Course Code: 994403**
3. **Advanced Game Design and Interactive Applications—Course Code: 994404**
4. **Capstone Project in Interactive Media Technology—Course Code: 994405**

Course Description: Foundations of Interactive Media Technology
This course introduces students to the essential skills and knowledge necessary for success in the interactive media industry. Key areas of focus include safety, ethical issues, career exploration, and foundational technical skills. Students will learn the basics of UI/UX, pre-production processes, and begin building a professional portfolio.

Course Description: Interactive Media Design and Development
Building on the foundations course, students will delve deeper into the principles and practices of interactive media design. They will explore game mechanics, 3D asset creation, environment and level design, and UI/UX design. Emphasis is placed on hands-on projects and refining their portfolio.

Course Description: Advanced Game Design and Interactive Applications
This course focuses on advanced topics in game design and interactive media, including localization, quality assurance, user testing, and multiplayer design. Students will engage in mentorship and apprenticeship opportunities, receive industry feedback, and refine their portfolios with advanced projects.

Course Description: Capstone Project in Interactive Media Technology
The capstone course provides students with the opportunity to apply their knowledge and skills in a comprehensive project. Working in teams, students will develop a significant interactive media project from concept to completion. The course culminates in a showcase presentation, allowing students to demonstrate their work to an audience.

Foundations of Interactive Media Technology—Course Code: 994402

Unit	Unit Title	Hours
1	Orientation, Safety and Interactive Media Fundamentals	10
2	Career Exploration and Industry Awareness	20
3	Ethics and Responsibility in Interactive Media Design	20
4	The Art of Pre-Production	40
5	UI/UX and Accessibility	30
6	Portfolio Foundations and Capstone Planning	20
Total		**140**

Interactive Media Design and Development—Course Code: 994403

Unit	Unit Title	Hours
7	Game Mechanics (Architecture and Mechanics in Interactive Media)	30
8	Create and Import Original Assets (Using a 3D Game Engine)	30
9	Environments and Level Design	30
10	UI/UX Design for Interactive Experiences	30
11	Portfolio Refinement and Capstone Proposal	20
Total		**140**

Advanced Game Design and Interactive Applications—Course Code: 994404

Unit	Unit Title	Hours
12	Localization and Marketing for Interactive Experiences	30
13	Quality Assurance, Debugging, and Technical Considerations	30
14	User Testing and Evaluation for Interactive Experiences	30
15	Basics of Multiplayer (Multiplayer, Co-op)	30
16	Mentorship/Apprenticeship Review/Evaluation	20
Total		**140**

Capstone Project in Interactive Media Technology—Course Code: 994405

Unit	Unit Title	Hours
17	Portfolio Showcase, Publishing, and Capstone Preparation	10
18	Team Formation, Ideation, and Proposal	10
19	Capstone Development (Phase 1)	30
20	Capstone Development (Phase 2)	30
21	Capstone Development (Phase 3)	30
22	Capstone Showcase and Presentation	30
Total		**140**

Option 2—Two 2-Carnegie Unit Courses

This curriculum consists of two 2-credit courses, which should be completed in the following sequence:

1. **Interactive Media Technology I—Course Code: 994400**
2. **Interactive Media Technology II—Course Code: 994401**

Course Description: Interactive Media Technology I
This course introduces the fundamentals of interactive media design, focusing on essential skills and concepts that form the foundation of the field. Students will become proficient in core software tools (such as Unreal Engine, Blender, Adobe Photoshop, and Audacity), develop an understanding of interactive media applications, and explore diverse career opportunities within the industry. The curriculum emphasizes ethical design practices, pre-production processes, UI/UX principles, and the creation of a professional portfolio. Throughout the course, students will engage in project-based learning, fostering collaboration, creativity, and critical thinking.

Course Description: Interactive Media Technology II
Building on the foundations established in Interactive Media Technology I, this course delves deeper into advanced concepts and practices within interactive media design. Students will explore localization, marketing strategies, quality assurance, and user testing for interactive experiences. The curriculum includes the design and implementation of multiplayer functionalities, mentorship and apprenticeship experiences, and extensive capstone project development. Emphasis is placed on refining professional portfolios, developing comprehensive project proposals, and showcasing final projects. This course prepares students for higher education and career opportunities in the interactive media industry, with a strong focus on real-world applications and industry standards.

Interactive Media Technology I—Course Code: 994400

Unit	Unit Title	Hours
1	Introduction, Safety, and Orientation	10
2	Career Exploration and Industry Awareness	20
3	Ethics and Responsibility in Interactive Media Design	20
4	The Art of Pre-Production	40
5	UI/UX and Accessibility	30
6	Portfolio Foundations and Capstone Planning	20
7	Game Mechanics (Architecture and Mechanics in Interactive Media)	30
8	Create and Import Original Assets (Using a 3D Game Engine)	30
9	Environments and Level Design	30
10	UI/UX Design for Interactive Experiences	30
11	Portfolio Refinement and Capstone Proposal	20
Total		**280**

Interactive Media Technology II—Course Code: 994401

Unit	Unit Title	Hours
12	Localization and Marketing for Interactive Experiences	30

13	Quality Assurance, Debugging, and Technical Considerations	30
14	User Testing and Evaluation for Interactive Experiences	30
15	Basics of Multiplayer (Multiplayer, Co-op)	30
16	Mentorship/Apprenticeship Review/Evaluation	20
17	Portfolio Showcase, Publishing, and Capstone Preparation	10
18	Team Formation, Ideation, and Proposal	10
19	Capstone Development (Phase 1)	30
20	Capstone Development (Phase 2)	30
21	Capstone Development (Phase 3)	30
22	Capstone Showcase and Presentation	30
Total		**280**

Career Pathway Outlook

Overview
The Interactive Media Technology (IMT) pathway focuses on preparing students for careers in the game design and interactive media industry. This pathway equips students with foundational knowledge, technical skills, and hands-on experience in creating, developing, and producing interactive media projects. Emphasizing both creative and technical aspects, the curriculum covers topics such as game mechanics, user experience design, 3D modeling, and digital storytelling. Students will also develop professional portfolios and participate in capstone projects to showcase their skills.

Needs of the Future Workforce
Mississippi's interactive media and game design industry is growing steadily, although at a smaller scale compared to national figures. The demand for digital content and interactive media solutions is increasing, providing new opportunities for careers in game design, multimedia development, and related fields.

Table 1.1: Current and Projected Occupation Report

Description	Jobs, 2020	Projected Jobs, 2030	Change (Number)	Change (Percent)	Average Hourly Earning, 2024
Game Designers	450	500	50	11.1%	$35.50
Multimedia Artists and Animators	600	660	60	10.0%	$31.00
Software Developers (Applications)	1,800	2,000	200	11.1%	$46.50
Audio and Video Equipment Technicians	230	280	50	21.7%	$21.53

Source: Mississippi Department of Employment Security; mdes.ms.gov (2024).

Perkins V Requirements and Academic Infusion
The Interactive Media Technology (IMT) curriculum meets Perkins V requirements of introducing students to and preparing them for high-skill, high-wage occupations in IMT fields. It also offers students a program of study, including secondary, postsecondary, and institutions of higher learning courses, that will further prepare them for IMT careers. Additionally, this curriculum is integrated with academic college- and career-readiness standards. Lastly, it focuses on ongoing and meaningful professional development for teachers as well as relationships with industry.

Transition to Postsecondary Education
The latest articulation information for secondary to postsecondary can be found at the Mississippi Community College Board website, mccb.edu.

Best Practices

Innovative Instructional Technologies

Classrooms should be equipped with tools that will teach today's digital learners through applicable and modern practices. The Interactive Media Technology (IMT) educator's goal should be to include teaching strategies that incorporate current technology. To make use of the latest online communication tools—wikis, blogs, podcasts, and social media platforms, for example—the classroom teacher is encouraged to use a learning management system that introduces students to education in an online environment and places more of the responsibility of learning on the student.

Differentiated Instruction

Students learn in a variety of ways, and numerous factors—students' background, emotional health, and circumstances, for example—create unique learners. By providing various teaching and assessment strategies, students with various learning preferences can have more opportunities to succeed.

CTE Student Organizations

Teachers should investigate opportunities to sponsor a student organization. There are several here in Mississippi that will foster the types of learning expected from the IMT curriculum. SkillsUSA, TSA, and FBLA are examples of student organizations with many outlets for multimedia careers. Student organizations provide participants and members with growth opportunities and competitive events. They also open the doors to the world of IMT careers and scholarship opportunities.

Cooperative Learning

Cooperative learning can help students understand topics when independent learning cannot. Therefore, you will see several opportunities in the IMT curriculum for group work. To function in today's workforce, students need to be able to work collaboratively with others and solve problems without excessive conflict. The IMT curriculum provides opportunities for students to work together and help each other complete complex tasks. There are many field experiences within the IMT curriculum that will allow and encourage collaboration with professionals currently in the multimedia field.

Work-Based Learning

Work-based learning is an extension of understanding competencies taught in the IMT classroom. This curriculum is designed in a way that necessitates active involvement by the students in the community around them and the global environment. These real-world connections and applications link all types of students to knowledge, skills, and professional dispositions. Work-based learning should encompass ongoing and increasingly more complex involvement with local companies and IMT professionals. Thus, supervised collaboration and immersion into the multimedia platforms around the students are key to students' success, knowledge, and skills development.

Professional Organizations

Association of Career and Technical Education
acteonline.org

Future Business Leaders of America
fbla-pbl.org

International Game Developers Association
igda.org

International Society for Technology in Education
iste.org

Technology Student Association
tsaweb.org

Using This Document

Competencies and Suggested Objectives
A competency represents a general concept or performance that students are expected to master as a requirement for satisfactorily completing a unit. Students will be expected to receive instruction on all competencies. The suggested objectives represent the enabling and supporting knowledge and performances that will indicate mastery of the competency at the course level.

Teacher Resources
All teachers should request to be added to the Canvas Resource Guide for their course. For questions or to be added to the guide, send a Help Desk ticket to the RCU by emailing helpdesk@rcu.msstate.edu.

Perkins V Quality Indicators and Enrichment Material
Some of the units may include an enrichment section at the end. This material will greatly enhance the learning experiences of students. If the Interactive Media Technology (IMT) program is using a national certification, work-based learning, or another measure of accountability that aligns with Perkins V as a quality indicator, this material could very well be assessed on that quality indicator. It is the responsibility of the teacher to ensure all competencies for the selected quality indicator are covered throughout the year.

Unit 1: Introduction, Safety, and Orientation

Competencies and Suggested Objectives
1. Demonstrate proficiency with the interfaces and essential tools in core software. DOK2 a. Develop familiarity with interfaces and navigation in multiple software options (e.g., Unreal Engine, Unity, Blender, Adobe Photoshop, GNU image Manipulation Program (GIMP), Audacity, GarageBand). b. Utilize image editing tools for basic image editing and manipulation. c. Explore audio editing tools for audio editing and basic sound design techniques.
2. Demonstrate safe, organized, and responsible digital practices. DOK3 a. Implement effective file management practices within the interactive media design workflow. b. Adhere to version control protocols for collaborative projects using tools like Git or SVN. c. Practice responsible online conduct and basic cybersecurity measures.
3. Understand and apply safety protocols relevant to interactive media technology. DOK2 a. Identify and follow safety procedures specific to interactive media production environments. b. Complete a safety test demonstrating understanding of safety protocols and procedures. c. Maintain a safe and ergonomic workspace.

Unit 2: Career Exploration and Industry Awareness

Competencies and Suggested Objectives
1. Discover careers in interactive media design. DOK2 a. Research diverse roles within the interactive media industry, including but not limited to user experience (UX) designer, concept artist, interactive programmer, and sound designer. b. Identify the required skills, knowledge, and educational pathways for various interactive media careers. c. Conduct informational interviews with professionals in the field and present findings to the class.
2. Explore the interactive media industry. DOK2 a. Research major companies and influential figures in the interactive media industry. b. Evaluate potential social and cultural impacts of interactive media design choices. c. Promote respectful collaboration and contribute to positive online communities.
3. Craft a personal exploration roadmap. DOK3 a. Reflect on individual interests and strengths aligning with interactive media careers. b. Develop a plan with short-term learning goals and exploration resources (online tutorials, workshops, relevant extracurriculars).

Unit 3: Ethics and Responsibility in Interactive Media Design

Competencies and Suggested Objectives
1. Analyze ethical considerations in interactive media design. DOK2 a. Investigate concepts of accessibility, representation, inclusion, and responsible design. b. Evaluate potential social and cultural impacts of interactive media design choices.
2. Practice ethical and inclusive design. DOK3 a. Understand, respect, and apply intellectual property, copyright, and fair use practices. b. Promote respectful collaboration and contribute to positive online communities.
3. Understand the ethical use of artificial intelligence (AI) in interactive media. DOK2 a. Explore ethical concerns and guidelines for using AI in media creation and user interaction. b. Analyze the benefits and risks of AI applications in interactive media.
4. Examine case studies of ethical dilemmas in interactive media. DOK3 a. Study historical and contemporary examples of ethical dilemmas in interactive media design. b. Develop strategies for addressing ethical challenges in future projects.
5. Develop and maintain a digital portfolio to showcase student work. DOK3 a. Continuously update the digital portfolio with work from each unit. b. Reflect on personal growth and learning through the portfolio entries.

Unit 4: The Art of Pre-Production

Competencies and Suggested Objectives
1. Implement the pre-production design process. DOK3 a. Explain the iterative stages of pre-production (conceptualization, brainstorming, prototyping, etc.). b. Create effective design documentation (problem statements, user personas, sketches, flowcharts). c. Develop storyboards and wireframes for project planning.
2. Prototype interactive experiences. DOK3 a. Select appropriate tools for rapid prototyping (physical, digital, or a combination). b. Design and implement core interactive elements within a prototype demonstrating a clear concept. c. Evaluate and iterate on prototypes based on feedback and testing.
3. Develop storytelling and narrative techniques. DOK3 a. Integrate narrative structures into interactive media projects. b. Create compelling characters, settings, and plots for interactive experiences. c. Utilize techniques for nonlinear storytelling.
4. Understand and apply user-centered design principles. DOK3 a. Define and apply user-centered design principles in pre-production. b. Conduct user research to inform design decisions. c. Develop and use personas to guide design and development.
5. Develop and maintain a digital portfolio to showcase student work. DOK3 a. Continuously update the digital portfolio with work from each unit. b. Reflect on personal growth and learning through the portfolio entries.

Unit 5: User Interface (UI)/User Experience(UX) and Accessibility

Competencies and Suggested Objectives
1. Analyze principles of UI/UX and accessibility. DOK3 a. Define key UI/UX concepts (usability, navigation, feedback, visual hierarchy, accessibility principles). b. Critically evaluate the UI/UX of various interactive examples, identifying strengths, weaknesses, and accessibility considerations. c. Discuss the importance of accessibility in interactive media design.
2. Design user-centered and inclusive interfaces. DOK3 a. Apply UI design principles (layout, color theory, typography, etc.) to create wireframes or mockups. b. Design for accessibility (e.g., alternative input methods, adjustable settings). c. Incorporate user feedback through usability testing.
3. Implement UI/UX design in interactive media projects. DOK3 a. Develop user interfaces for interactive media projects using design software (e.g., Adobe XD, Figma, Sketch). b. Integrate accessibility features into interactive media projects. c. Test and iterate on user interface designs based on user feedback.
4. Understand the role of UI/UX in user experience. DOK2 a. Analyze how UI/UX affects overall user experience in interactive media. b. Explore case studies of successful and unsuccessful UI/UX designs.
5. Develop and maintain a digital portfolio to showcase student work. DOK3 a. Continuously update the digital portfolio with work from each unit. b. Reflect on personal growth and learning through the portfolio entries.

Unit 6: Portfolio Foundations and Capstone Planning

Competencies and Suggested Objectives
1. Curate an interactive media portfolio. DOK3 a. Identify essential elements of a compelling interactive media portfolio. b. Select and showcase projects demonstrating skills, interests, and design thinking. c. Develop presentation skills for showcasing work (oral, written, pictorial, video, and peer review).
2. Conceptualize and plan a team capstone project. DOK3 a. Brainstorm potential project ideas in collaboration with team members, aligning with individual strengths and course competencies. b. Define the scope, goals, target audience, and accessibility considerations for the capstone project. c. Develop a collaborative project plan outlining methodology, resource requirements, timeline, and individual roles (using Trello or a similar task management tool).

Unit 7: Game Mechanics (Architecture and Mechanics in Interactive Media)

Competencies and Suggested Objectives
1. Analyze game mechanics in diverse interactive media. DOK3 a. Deconstruct mechanics in various genres (platformers, simulations, strategy, etc.), identifying their core elements and functions. b. Examine how mechanics create different player experiences, drive engagement, and support the overall design goals. c. Analyze the balance between challenge and skill in-game mechanics to maintain player engagement.
2. Design and implement game mechanics. DOK3 a. Conceptualize game mechanics aligned with desired player experiences and project themes. b. Utilize game engine scripting tools (e.g., Blueprints, C++, Unity scripts) to implement and refine core game mechanics. c. Test and iterate on game mechanics based on player feedback and performance data. d. Integrate advanced game mechanics such as physics-based interactions, AI behaviors, and procedural generation.
3. Evaluate the impact of game mechanics on user experience DOK3 a. Assess how different mechanics affect user engagement, satisfaction, and retention. b. Conduct user testing to gather qualitative and quantitative data on player interactions with game mechanics. c. Use analytics tools to measure the effectiveness of implemented mechanics and identify areas for improvement.
4. Determine the ethical considerations of in-game mechanics design. DOK3 a. Explore the ethical implications of game mechanics, such as loot boxes, difficulty settings, and in-game purchases. b. Design game mechanics that promote positive player behavior and inclusivity. c. Evaluate the social and cultural impacts of game mechanics on diverse player groups.

Unit 8: Create and Import Original Assets (Using a 3D Game Engine)

Competencies and Suggested Objectives
1. Master essential 3D modeling techniques. DOK3 a. Develop proficiency in 3D modeling software (e.g., Blender, Maya, 3ds Max) to create basic and complex models. b. Apply texturing and UV unwrapping techniques to prepare models for real-time rendering. c. Optimize 3D models for performance, considering polygon count and texture resolution.
2. Integrate assets into an interactive experience. DOK3 a. Understand file formats and import pipelines for 3D assets within a game engine (e.g., Unreal Engine, Unity). b. Apply materials, lighting, and physics properties to imported assets within the game engine. c. Troubleshoot common issues in asset integration and rendering.
3. Design and develop interactive environments. DOK3 a. Utilize environment design principles to create immersive game worlds. b. Implement modular design techniques for efficient building of the environment. c. Integrate assets into the game environment to enhance storytelling and gameplay.

Unit 9: Environments and Level Design

Competencies and Suggested Objectives
1. Understand principles of interactive environment design. DOK3 a. Analyze level design in various interactive media, focusing on pacing, guidance, storytelling through environment, and themes. b. Apply concepts of modular design, asset reuse, and worldbuilding techniques to create engaging environments. c. Evaluate the impact of environmental design on player experience and engagement.
2. Build interactive environments. DOK3 a. Utilize 3D modeling tools (e.g., Blender, Maya, 3ds Max) to create modular environment assets. b. Design, assemble, and light levels within a game engine (e.g., Unreal Engine, Unity) to demonstrate effective layout, player guidance, and thematic consistency. c. Integrate environmental storytelling elements to enhance the narrative and player immersion. d. Implement and test dynamic environments that respond to player actions and changes within the game world.

Unit 10: UI/UX Design for Interactive Experiences

Competencies and Suggested Objectives
1. Analyze UI/UX in interactive experiences. DOK3 a. Define key UI/UX concepts such as usability, navigation, feedback, visual hierarchy, and consistency. b. Evaluate the UI/UX of various interactive examples, identifying strengths, weaknesses, and how it supports gameplay. c. Understand the role of UI/UX design in enhancing player engagement and overall user experience.
2. Design and implement user interfaces. DOK3 a. Apply UI design principles within design software (e.g., Adobe Photoshop, Figma, Sketch) to create wireframes and mockups. b. Utilize game engine UI tools (e.g., Unreal Engine's UMG/Widget Blueprints, Unity's UI system) to design and implement functional in-game user interfaces. c. Integrate user feedback through usability testing to refine and improve UI designs. d. Ensure accessibility considerations are met in the design of user interfaces.
3. Prototype interactive experiences. DOK3 a. Select appropriate tools for rapid prototyping (physical, digital, or a combination, including basic visual scripting within Unreal Engine). b. Design and implement core interactive elements within a prototype demonstrating a clear concept. c. Iteratively test and refine prototypes based on user feedback.
4. Develop and maintain a digital portfolio. DOK3 a. Continuously update the digital portfolio with work from each unit. b. Reflect on personal growth and learning through the portfolio entries. c. Showcase projects that demonstrate skills, interests, and design thinking.

Unit 11: Portfolio Refinement and Capstone Proposal

Competencies and Suggested Objectives
1. Enhance and present interactive media portfolio. DOK3 a. Refine and expand the interactive media portfolio, incorporating projects from previous units to showcase the progression of skills and interests. b. Develop compelling presentation materials (e.g., project briefs, videos, process documentation) to articulate design choices and technical achievements. c. Practice presenting the portfolio, highlighting strengths and effectively communicating the creative process.
2. Finalize and propose capstone project. DOK3 a. In collaboration with team members, refine the capstone project scope, goals, and detailed plan outlining methodology, resource requirements, timeline, and individual roles. b. Create a comprehensive capstone proposal document or presentation clearly communicating the project's vision, potential impact, and feasibility. c. Conduct peer reviews to receive constructive feedback and further refine the capstone proposal.

Unit 12: Localization and Marketing for Interactive Experiences

Competencies and Suggested Objectives
1. Understand localization for interactive experiences. DOK2 a. Define localization and its importance in adapting interactive media for global audiences. b. b. Explore challenges and best practices in localizing assets (text, audio, visuals, gameplay elements).
2. Develop a marketing strategy for interactive experiences. DOK3 a. Identify key elements of a marketing plan for interactive media products. b. Research target audiences and create marketing materials that resonate with their interests. c. Understand and apply principles of digital marketing, including social media strategies and analytics.
3. Analyze the impact of cultural differences on interactive media. DOK3 a. Evaluate how cultural differences affect user experience and engagement. b. Adapt design elements to suit diverse cultural contexts.

Unit 13: Quality Assurance, Debugging, and Technical Considerations

Competencies and Suggested Objectives
1. Implement quality assurance practices. DOK3 a. Understand the role of quality assurance (QA) in interactive media development. b. Design test cases and conduct debugging sessions to identify and resolve issues. c. Report issues effectively using bug tracking tools.
2. Optimize for performance and cross-platform compatibility. DOK3 a. Identify technical considerations for cross-platform development (e.g., UI scaling, input methods). b. Apply optimization techniques to improve performance on various devices. c. Conduct performance testing to ensure smooth gameplay across different platforms.
3. Incorporate advanced debugging techniques. DOK3 a. Utilize advanced debugging tools and techniques to troubleshoot complex issues. b. Implement automated testing scripts to streamline the QA process. c. Analyze debugging data to identify recurring issues and develop long-term solutions.

Unit 14: User Testing and Evaluation for Interactive Experiences

Competencies and Suggested Objectives
1. Conduct user testing for interactive experiences. DOK3 a. Understand different user testing methodologies and their suitability for various development stages (playtesting, usability testing, accessibility testing, concept testing). b. Design test plans outlining goals, target participants, and specific tasks or scenarios to be tested. c. Recruit diverse participants, moderate testing sessions, and collect feedback effectively.
2. Analyze and apply user feedback. DOK3 a. Utilize qualitative and quantitative analysis methods to interpret user feedback. b. Identify patterns and prioritize issues based on user feedback. c. Propose design solutions and iterations based on user testing insights.
3. Evaluate the effectiveness of user testing. DOK3 a. Assess the effectiveness of user testing methodologies in identifying usability issues. b. Evaluate the impact of user feedback on the development process. c. Reflect on the overall user testing process and suggest improvements for future projects.

Unit 15: Basics of Multiplayer (Multiplayer, Co-op)

Competencies and Suggested Objectives
1. Evaluate fundamentals of multiplayer design. DOK3 a. Explore multiplayer concepts such as networking, synchronization, and gameplay modes. b. Analyze multiplayer features in existing interactive experiences, understanding their impact on player engagement and social interaction. c. Discuss the challenges and best practices in designing and implementing multiplayer experiences.
2. Prototype a multiplayer experience. DOK3 a. Utilize game engine networking tools to implement basic multiplayer functionality (e.g., Unreal Engine's networking tools, Unity's Mirror). b. Design and test a simple co-op or competitive multiplayer experience. c. Iterate on the multiplayer prototype based on playtesting feedback.
3. Implement advanced multiplayer features. DOK4 a. Integrate advanced features such as matchmaking, leaderboards, and voice chat. b. Ensure security and fair play in multiplayer environments. c. Optimize the multiplayer experience for performance and scalability.

Unit 16: Mentorship/Apprenticeship Review/Evaluation

Competencies and Suggested Objectives
1. Engage in mentorship. DOK3 a. Participate in industry mentor feedback sessions, demonstrating receptiveness to constructive criticism. b. Utilize mentor feedback to improve projects and refine skill development. c. Develop professional communication and networking skills through mentor interactions.
2. Engage in self-assessment and goal setting practices. DOK3 a. Critically reflect on individual progress and accomplishments throughout the course. b. Develop a post-course action plan for continued skill development and career exploration within interactive media. c. Set specific, measurable, achievable, relevant, and time-bound (SMART) goals for future growth.
3. Evaluate the impact of mentorship on professional growth. DOK4 a. Assess the effectiveness of mentorship sessions in enhancing technical and soft skills. b. Reflect on the overall mentorship experience and its influence on career aspirations. c. Identify areas for improvement in future mentorship or apprenticeship opportunities.

Unit 17: Portfolio Showcase, Publishing, and Capstone Preparation

Competencies and Suggested Objectives
1. Prepare, publish, and present a polished interactive media portfolio. DOK 3 a. Refine the portfolio to highlight the breadth and depth of skills developed across all units. b. Select a suitable online platform (e.g., Adobe Portfolio, Behance, Google Sites, custom website) and publish the portfolio, ensuring a professional presentation and discoverability. c. Create compelling presentation materials (e.g., portfolio highlights, demo reel) to showcase projects and capabilities.
2. Launch the capstone project. DOK3 a. Form collaborative teams or solidify individual project directions for the capstone. b. Utilize portfolio strengths to define roles and responsibilities for the capstone, ensuring effective team dynamics. c. Develop a detailed capstone project plan, including timeline, resources, and milestones.
3. Evaluate the effectiveness of the portfolio and capstone planning. DOK4 a. Assess the quality and impact of the portfolio in demonstrating skills and achievements. b. Reflect on the planning process for the capstone project and identify potential improvements. c. Present the capstone project plan to peers and instructors for feedback and approval.

Unit 18: Team Formation, Ideation and Proposal

Competencies and Suggested Objectives
1. Develop team collaboration skills through the formation and ideation process. DOK3 a. Form effective teams by identifying individual strengths and aligning them with project roles. b. Facilitate brainstorming sessions to generate project ideas collaboratively. c. Utilize project management tools (e.g., Trello, Asana) to organize and assign tasks.
2. Create detailed project proposals outlining the scope, goals, and methodologies. DOK3 a. Define the project scope, including objectives, deliverables, and constraints. b. Establish clear project goals and success criteria. c. Develop a project timeline with milestones and deadlines.
3. Present proposals and receive feedback for refinement and finalization. DOK3 a. Prepare a professional project proposal presentation. b. Present the proposal to peers, mentors, or stakeholders for feedback. c. Refine the proposal based on constructive criticism and finalize it for approval.

Unit 19: Capstone Development (Phase 1)

Competencies and Suggested Objectives
1. Implement initial project development for the capstone. DOK3 a. Define the initial development tasks and responsibilities for team members. b. Develop a preliminary project plan outlining key milestones and deadlines. c. Begin the design and development of project components, including concept art, wireframes, and prototypes.
2. Apply specialized skills and tools to contribute to the project's success. DOK3 a. Utilize design software and development tools to create project assets. b. Collaborate with team members to integrate individual contributions. c. Conduct regular project meetings to monitor progress and address challenges.
3. Document the development process and maintain organized records. DOK2 a. Keep detailed records of development tasks and milestones. b. Document design decisions and changes throughout the project. c. Prepare regular progress reports to share with mentors and stakeholders.

Unit 20: Capstone Development (Phase 2)

Competencies and Suggested Objectives
1. Advance the development and refinement of the capstone project. DOK3 a. Implement feedback from initial reviews to enhance project components. b. Develop advanced features and functionalities based on the project plan. c. Conduct thorough testing and debugging of project components.
2. Apply project management techniques to maintain project momentum. DOK3 a. Utilize project management tools to track progress and update timelines. b. Ensure effective communication and collaboration within the team. c. Identify and mitigate potential risks and challenges in project development.
3. Document and present intermediate progress to stakeholders. DOK2 a. Prepare detailed progress reports and presentations. b. Conduct interim presentations to gather feedback from mentors and peers. c. Revise project goals and plans based on stakeholder feedback.

Unit 21: Capstone Development (Phase 3)

Competencies and Suggested Objectives
1. Prepare, publish, and present the capstone project. DOK3 a. Develop compelling presentation materials (e.g., demos, documentation, videos) to showcase the project. b. Present the capstone project to an audience, highlighting its unique aspects, the development process, and individual contributions.
2. Reflect on the collaborative experience. DOK3 a. Evaluate both the project outcome and the team's collaborative process. b. Articulate lessons learned and areas for improvement in future team-based projects.

Unit 22: Capstone Showcase and Presentation

Competencies and Suggested Objectives
1. Present the capstone project. DOK3 a. Develop comprehensive presentation materials (e.g., demos, documentation, videos) to showcase the project. b. Deliver a professional presentation of the capstone project to an audience, highlighting its unique aspects, the development process, and individual contributions.
2. Reflect on the capstone experience. DOK3 a. Evaluate both the project outcome and the team's collaborative process. b. Articulate lessons learned and areas for improvement in future projects.

Student Competency Profile

Student's Name: _____

This record is intended to serve as a method of noting student achievement of the competencies in each unit. It can be duplicated for each student, and it can serve as a cumulative record of competencies achieved in the course.

In the blank before each competency, write in the date on which the student mastered the competency.

Unit 1: Introduction, Safety, and Orientation		
	1.	Demonstrate proficiency with the interfaces and essential tools in core software.
	2.	Demonstrate safe, organized, and responsible digital practices.
	3.	Understand and apply safety protocols relevant to interactive media technology.
Unit 2: Career Exploration and Industry Awareness		
	1.	Discover careers in interactive media design.
	2.	Explore the interactive media industry.
	3.	Craft a personal exploration roadmap.
Unit 3: Ethics and Responsibility in Interactive Media Design		
	1.	Analyze ethical considerations in interactive media design.
	2.	Practice ethical and inclusive design.
	3.	Understand ethical use of AI in interactive media.
	4.	Examine case studies of ethical dilemmas in interactive media.
	5.	Develop and maintain a digital portfolio to showcase student work.
Unit 4: The Art of Pre-Production		
	1.	Implement the pre-production design process.
	2.	Prototype interactive experiences.
	3.	Develop storytelling and narrative techniques.
	4.	Understand and apply user-centered design principles.
	5.	Develop and maintain a digital portfolio to showcase student work.
Unit 5: UI/UX and Accessibility		
	1.	Analyze principles of UI/UX and accessibility.
	2.	Design user-centered and inclusive interfaces.
	3.	Implement UI/UX design in interactive media projects.
	4.	Understand the role of UI/UX in user experience.
	5.	Develop and maintain a digital portfolio to showcase student work.

Unit 6: Portfolio Foundations and Capstone Planning		
	1.	Curate an interactive media portfolio.
	2.	Conceptualize and plan a team capstone project
Unit 7: Game Mechanics (Architecture and Mechanics in Interactive Media)		
	1.	Analyze game mechanics in diverse interactive media.
	2.	Design and implement game mechanics.
	3.	Evaluate the impact of game mechanics on user experience.
	4.	Determine the ethical considerations of in-game mechanics design.
Unit 8: Create and Import Original Assets (Using a 3D Game Engine)		
	1.	Master essential 3D modeling techniques.
	2.	Integrate assets into an interactive experience.
	3.	Design and develop interactive environments.
Unit 9: Environments and Level Design		
	1.	Understand principles of interactive environment design.
	2.	Build interactive environments.
Unit 10: UI/UX Design for Interactive Experiences		
	1.	Analyze UI/UX in interactive experiences.
	2.	Design and implement user interfaces.
	3.	Prototype interactive experiences.
	4.	Develop and maintain a digital portfolio.
Unit 11: Portfolio Refinement and Capstone Proposal		
	1.	Enhance and present interactive media portfolio.
	2.	Finalize and propose capstone project.
Unit 12: Localization and Marketing for Interactive Experiences		
	1.	Understand localization for interactive experiences.
	2.	Develop a marketing strategy for interactive experiences.
	3.	Analyze the impact of cultural differences on interactive media.
Unit 13: Quality Assurance Debugging and Technical Considerations		
	1.	Implement quality assurance practices.
	2.	Optimize for performance and cross-platform compatibility.
	3.	Advanced debugging techniques
Unit 14: User Testing and Evaluation for Interactive Experiences		
	1.	Conduct user testing for interactive experiences.
	2.	Analyze and apply user feedback.

	3.	Evaluate the effectiveness of user testing.
Unit 15: Basics of Multiplayer (Multiplayer Co-op)		
	1.	Evaluate fundamentals of multiplayer design.
	2.	Prototype a multiplayer experience.
	3.	Implement advanced multiplayer features.
Unit 16: Mentorship/Apprenticeship Review/Evaluation		
	1.	Engage in mentorship.
	2.	Engage in self-assessment and goal setting practices.
	3.	Evaluate the impact of mentorship on professional growth.
Unit 17: Portfolio Showcase, Publishing, and Capstone Preparation		
	1.	Prepare, publish, and present a polished interactive media portfolio.
	2.	Launch the capstone project.
	3.	Evaluate the effectiveness of the portfolio and capstone planning.
Unit 18: Team Formation, Ideation and Proposal		
	1.	Develop team collaboration skills through the formation and ideation process.
	2.	Create detailed project proposals outlining the scope, goals, and methodologies.
	3.	Present proposals and receive feedback for refinement and finalization.
Unit 19: Capstone Development (Phase 1)		
	1.	Implement initial project development for the capstone.
	2.	Apply specialized skills and tools to contribute to the project's success.
	3.	Document the development process and maintain organized records.
Unit 20: Capstone Development (Phase 2)		
	1.	Advance the development and refinement of the capstone project.
	2.	Apply project management techniques to maintain project momentum.
	3.	Document and present intermediate progress to stakeholders.
Unit 21: Capstone Development (Phase 3)		
	1.	Prepare, publish and present the capstone project.
	2.	Reflect on the collaborative experience.
Unit 22: Capstone Showcase and Presentation		
	1.	Present the capstone project.
	2.	Reflect on the capstone experience.

Appendix A: 21st Century Skills[1]

	Unit	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Standard																							
CS1																							
CS2		X					X				X												
CS3		X					X				X												
CS4																							
CS5																							
CS6		X			X	X	X	X	X	X	X	X	X		X	X							
CS7			X			X																	
CS8						X																	
CS9																							
CS10																							
CS11																							
CS12			X	X			X																
CS13		X						X	X	X	X	X			X	X							
CS14			X	X			X																
CS15			X	X																			
CS16																							

CSS1-21st Century Themes

CS1 Global Awareness

1. Using 21st century skills to understand and address global issues
2. Learning from and working collaboratively with individuals representing diverse cultures, religions, and lifestyles in a spirit of mutual respect and open dialogue in personal, work, and community contexts
3. Understanding other nations and cultures, including the use of non-English languages

CS2 Financial, Economic, Business, and Entrepreneurial Literacy

1. Knowing how to make appropriate personal economic choices
2. Understanding the role of the economy in society
3. Using entrepreneurial skills to enhance workplace productivity and career options

CS3 Civic Literacy

1. Participating effectively in civic life through knowing how to stay informed and understanding governmental processes
2. Exercising the rights and obligations of citizenship at local, state, national, and global levels
3. Understanding the local and global implications of civic decisions

CS4 Health Literacy

1. Obtaining, interpreting, and understanding basic health information and services and using such information and services in ways that enhance health
2. Understanding preventive physical and mental health measures, including proper diet, nutrition, exercise, risk avoidance, and stress reduction
3. Using available information to make appropriate health-related decisions
4. Establishing and monitoring personal and family health goals
5. Understanding national and international public health and safety issues

CS5 Environmental Literacy

[1] *21st century skills.* (n.d.). Washington, DC: Partnership for 21st Century Skills.

1. Demonstrate knowledge and understanding of the environment and the circumstances and conditions affecting it, particularly as relates to air, climate, land, food, energy, water, and ecosystems.
2. Demonstrate knowledge and understanding of society's impact on the natural world (e.g., population growth, population development, resource consumption rate, etc.).
3. Investigate and analyze environmental issues, and make accurate conclusions about effective solutions.
4. Take individual and collective action toward addressing environmental challenges (e.g., participating in global actions, designing solutions that inspire action on environmental issues).

CSS2-Learning and Innovation Skills

CS6 Creativity and Innovation
1. Think Creatively
2. Work Creatively with Others
3. Implement Innovations

CS7 Critical Thinking and Problem Solving
1. Reason Effectively
2. Use Systems Thinking
3. Make Judgments and Decisions
4. Solve Problems

CS8 Communication and Collaboration
1. Communicate Clearly
2. Collaborate with Others

CSS3-Information, Media and Technology Skills

CS9 Information Literacy
1. Access and Evaluate Information
2. Use and Manage Information

CS10 Media Literacy
1. Analyze Media
2. Create Media Products

CS11 ICT Literacy
1. Apply Technology Effectively

CSS4-Life and Career Skills

CS12 Flexibility and Adaptability
1. Adapt to change
2. Be Flexible

CS13 Initiative and Self-Direction
1. Manage Goals and Time
2. Work Independently
3. Be Self-directed Learners

CS14 Social and Cross-Cultural Skills
1. Interact Effectively with others

2. Work Effectively in Diverse Teams

CS15 Productivity and Accountability

1. Manage Projects
2. Produce Results

CS16 Leadership and Responsibility

1. Guide and Lead Others
2. Be Responsible to Others

Appendix B: International Society for Technology in Education Standards (ISTE)

	Units	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Standards																							
T1		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
T2		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
T3		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
T4		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
T5		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
T6		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
T7		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

International Society for Technology in Education (ISTE)

T1 Empowered Learner

Students leverage technology to take an active role in choosing, achieving and demonstrating competency in their learning goals, informed by the learning sciences.

a. Articulate and set personal learning goals, develop strategies leveraging technology to achieve them and reflect on the learning process itself to improve learning outcomes.
b. Build networks and customize their learning environments in ways that support the learning process.
c. Use technology to seek feedback that informs and improves their practice and to demonstrate their learning in a variety of ways.
d. Understand the fundamental concepts of technology operations, demonstrate the ability to choose, use and troubleshoot current technologies and are able to transfer their knowledge to explore emerging technologies.

T2 Digital Citizen

Students recognize the rights, responsibilities and opportunities of living, learning and working in an interconnected digital world, and they act and model in ways that are safe, legal and ethical.

a. Cultivate and manage their digital identity and reputation and are aware of the permanence of their actions in the digital world.
b. Engage in positive, safe, legal and ethical behavior when using technology, including social interactions online or when using networked devices.
c. Demonstrate an understanding of and respect for the rights and obligations of using and sharing intellectual property.
d. Manage their personal data to maintain digital privacy and security and are aware of data-collection technology used to track their navigation online.

T3 Knowledge Constructor

Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.

a. Plan and employ effective research strategies to locate information and other resources for their intellectual or creative pursuits.

b. Evaluate the accuracy, perspective, credibility and relevance of information, media, data or other resources.
c. Curate information from digital resources using a variety of tools and methods to create collections of artifacts that demonstrate meaningful connections or conclusions.
d. Build knowledge by actively exploring real-world issues and problems, developing ideas and theories and pursuing answers and solutions.

T4 Innovative Designer

Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.

a. Know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.
b. Select and use digital tools to plan and manage a design process that considers design constraints and calculated risks.
c. Develop, test and refine prototypes as part of a cyclical design process.
d. Exhibit a tolerance for ambiguity, perseverance and the capacity to work with open-ended problems.

T5 Computational Thinker

Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.

a. Formulate problem definitions suited for technology-assisted methods such as data analysis, abstract models and algorithmic thinking in exploring and finding solutions.
b. Collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making.
c. Break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.
d. Understand how automation works and use algorithmic thinking to develop a sequence of steps to create and test automated solutions.

T6 Creative Communicator

Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.

a. Choose the appropriate platforms and tools for meeting the desired objectives of their creation or communication.
b. Create original works or responsibly repurpose or remix digital resources into new creations.
c. Communicate complex ideas clearly and effectively by creating or using a variety of digital objects such as visualizations, models or simulations.
d. Publish or present content that customizes the message and medium for their intended audiences.

T7 Global Collaborator

Students use digital tools to broaden their perspectives and enrich their learning by collaborating with others and working effectively in teams locally and globally.

a. Use digital tools to connect with learners from a variety of backgrounds and cultures, engaging with them in ways that broaden mutual understanding and learning.
b. Use collaborative technologies to work with others, including peers, experts or community members, to examine issues and problems from multiple viewpoints.
c. Contribute constructively to project teams, assuming various roles and responsibilities to work effectively toward a common goal.
d. Explore local and global issues and use collaborative technologies to work with others to investigate solutions.

Appendix C: College and Career Ready Standards – English Language Arts

	Units	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Standards																							
CCR.RL.1		X			X										X								
CCR.RL.2		X								X													
CCR.RL.3				X									X										
CCR.RL.4					X			X										X					
CCR.RL.5		X								X													
CCR.RL.6													X										
CCR.RL.7		X		X																			x
CCR.RL.8						X										X							x
CCR.RL.											X												
CCR.RL.10					X														X				
CCR.RI.1			X																X				
CCR.RI.1							X																
CCR.RI.1												X											
CCR.W.1									X														
CCR.W.1															X								
CCR.W.1																	X						
CCR.W.1																				X			
CCR.W.1																					X		
CCR.W.1																						X	
CCR.W.1																							

2016 Mississippi College- and Career- Readiness Standards for English Language Arts: English I

RL Reading Literature

Key Ideas and Details

1. Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.
2. Determine the theme(s) or central idea(s) of a text and analyze in detail the development over the course of the text, including how details of a text interact and build on one another to shape and refine the theme(s) or central idea(s); provide an accurate summary of the text based upon this analysis.
3. Analyze how complex characters (e.g., those with multiple or conflicting motivations) develop over the course of a literary text, interact with other characters, and advance the plot or develop the theme.

Craft and Structure

4. Determine the meaning of words and phrases as they are used in the text, including figurative and connotative meanings; analyze the cumulative impact of specific word choices on meaning and tone (e.g., how the language evokes a sense of time and place; how it sets a formal or informal tone).
5. Analyze how an author's choices concerning how to structure a text, order events within it (e.g., parallel plots), and manipulate time (e.g., pacing, flashbacks) create such effects as mystery, tension, or surprise.
6. Analyze a particular point of view or cultural experience reflected in a work of literature from outside the United States, drawing on a wide reading of world literature.

Integration of Knowledge and Ideas

7. Analyze the representation of a subject or a key scene in two different artistic mediums, including what is emphasized or absent in each treatment (e.g., Auden's "Musée des Beaux Arts" and Breughel's Landscape with the Fall of Icarus).
8. Not applicable to literature.
9. Analyze how an author draws on and transforms source material in a specific work (e.g., how Shakespeare treats a theme or topic from Ovid or the Bible or how a later author draws on a play by Shakespeare).

Range of Reading and Level of Text Complexity

10. By the end of grade 9, read and comprehend literature, including stories, dramas, and poems, in the grades 9-10 text complexity band proficiently, with scaffolding as needed at the high end of the range.

RI Reading Informational Text

Key Ideas and Details

1. Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.
2. Determine central idea(s) of a text and analyze in detail the development over the course of the text, including how details of a text interact and build on one another to shape and refine the central idea(s); provide an accurate summary of the text based upon this analysis.
3. Analyze how the author unfolds an analysis or series of ideas or events, including the order in which the points are made, how they are introduced and developed, and the connections that are drawn between them.

W Writing

Text Types and Purposes

1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.
    a. Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among claim(s), counterclaims, reasons, and evidence.
    b. Develop claim(s) and counterclaims fairly, supplying evidence for each while pointing out the strengths and limitations of both in a manner that anticipates the audience's knowledge level and concerns.
    c. Use words, phrases, and clauses to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
    d. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
    e. Provide a concluding statement or section that follows from and supports the argument presented.
2. Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.
    a. Introduce a topic; organize complex ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.

b. Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.
c. Use appropriate and varied transitions to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.
d. Use precise language and domain-specific vocabulary to manage the complexity of the topic.
e. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
f. Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).

3. Write narratives to develop real or imagined experiences or events using effective technique, well-chosen details, and well-structured event sequences.
   a. Engage and orient the reader by setting out a problem, situation, or observation, establishing one or multiple point(s) of view, and introducing a narrator and/or characters; create a smooth progression of experiences or events.
   b. Use narrative techniques, such as dialogue, pacing, description, reflection, and multiple plot lines, to develop experiences, events, and/or characters.
   c. Use a variety of techniques to sequence events so that they build on one another to create a coherent whole.
   d. Use precise words and phrases, telling details, and sensory language to convey a vivid picture of the experiences, events, setting, and/or characters.
   e. Provide a conclusion that follows from and reflects on what is experienced, observed, or resolved over the course of the narrative.

Production and Distribution of Writing

4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1–3 above.)
5. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. (Editing for conventions should demonstrate command of Language standards 1–3 up to and including grades 9–10.)
6. Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.

Research to Build and Present Knowledge

7. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

Appendix D: College and Career Ready Standards – Mathematics

	Units	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Standards																							
CCR.M1		X	X	X	X	X			X														
CCR.M2		X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	
CCR.M3							X	X	X														
CCR.M4				X	X	X		X		X	X	X	X	X	X	X	X	X	X	X	X	X	
CCR.M5		X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
CCR.M6				X			X																
CCR.M7		X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	
CCR.M8				X	X	X	X	X	X	X													
CCR.M9		X	X		X	X	X	X	X														
CCR.M10			X	X	X	X	X		X														
CCR.M11		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
CCR.M12					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
CCR.M13		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
CCR.M14		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
CCR.M15		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
CCR.M16		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
CCR.M17			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
CCR.M18		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
CCR.M19		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
CCR.M20		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	

College and Career Readiness Mathematics Standards

M1 Make sense of problems and persevere in solving them.
- Understand the problem-solving process and persevere to find solutions.

M2 Reason abstractly and quantitatively.
- Interpret mathematical problems abstractly and quantitatively, creating coherent representations.

M3 Construct viable arguments and critique the reasoning of others.
- Formulate and present mathematical arguments, analyze and critique the reasoning of others.

M4 Model with mathematics.
- Apply mathematics to solve real-world problems and interpret the results.

M5 Use appropriate tools strategically.
- Select and use mathematical tools and technology effectively.

M6 Attend to precision.
- Communicate mathematical reasoning with precision and accuracy.

M7 Look for and make use of structure.
- Identify and utilize mathematical structures to solve problems.

M8 Look for and express regularity in repeated reasoning.
- Recognize patterns and repeated reasoning in problem-solving processes.

M9 Understand the concept of a function and use function notation.
- Comprehend and use functions to model relationships between quantities.

M10 Interpret functions that arise in applications in terms of the context.
- Analyze and interpret functions in real-world contexts.

M11 Analyze functions using different representations.

- Examine functions using graphical, numerical, analytical, and verbal representations.

M12 Build a function that models a relationship between two quantities.

- Create functions to represent relationships between variables.

M13 Build new functions from existing functions.

- Construct new functions by modifying existing ones.

M14 Construct and compare linear, quadratic, and exponential models and solve problems.

- Develop and analyze linear, quadratic, and exponential models for problem-solving.

M15 Interpret expressions for functions in terms of the situation they model.

- Understand and explain expressions representing real-world situations.

M16 Perform arithmetic operations on polynomials.

- Conduct operations with polynomials, understanding their properties and applications.

M17 Understand the relationship between zeros and factors of polynomials.

- Explore the connections between polynomial factors and their zeros.

M18 Use polynomial identities to solve problems.

- Apply polynomial identities in problem-solving scenarios.

M19 Rewrite rational expressions.

- Manipulate and simplify rational expressions.

M20 Create equations that describe numbers or relationships.

- Formulate equations to represent numerical relationships and solve them.