2022 Collision Repair Technician—Paint

Program CIP: 47.0603—Autobody/Collision and Repair Technology/Technician

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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.

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Acknowledgments

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Dr. Carey M. Wright, state superintendent of education
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Sam Watts, the curriculum manager for the RCU

Standards

Standards and alignment crosswalks are referenced in the appendix. 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 collision repair technician curriculum is aligned to the following standards:

Automotive Service Excellence (ASE) Education Foundation Standards
The ASE Education Foundation is a nonprofit organization that evaluates and accredits entry-level automotive technology education programs against standards developed by the automotive service industry. It also develops career-readiness education for students that fuses local partnerships, rigorous standard-based education, workplace experience, and mentorship.
aseeducationfoundation.org

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

College- and Career-Readiness 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-Readiness 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

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* (2019).
battelleforkids.org/networks/p21/frameworks-resources

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, call the RCU at 662.325.2510.

Executive Summary

Pathway Description
Collision repair technician is a pathway for students in the transportation career cluster. The following description is from the current Standard Course of Study for Career-Technical Education, Mississippi Department of Education. Collision Repair is a hands-on program that will prepare students for employment or continuing education in the collision repair industry. The content is based on industry content. The content consists of fundamentals of collision, nonstructural analysis and damage repair, structural analysis and damage repair, and painting and refinishing.

The program is aligned with the ASE 2021 Collision Repair and Refinishing standards, which were retrieved March 25, 2021, from aseeducationfoundation.org/uploads/2021-Collision-Program-Standards-FV-13Jan2021.pdf.

College, Career, and Certifications
The collision repair technician pathway was written to incorporate the ASE Education Foundation. Any student who successfully completes this program will be eligible to apply to take the ASE exams. ASE requires two years of employment before certificates are issued. Students receive one year of credit for completion of the secondary program. Students who take certifications before meeting the two-year requirement will be granted certifications after completing one year of collision repair employment. Each district should implement a maximum student number due to the size of each lab. Programs seeking certification may receive certification in painting and refinishing or in other areas if they so desire.

Grade Level and Class Size Recommendations
It is recommended that students enter this program as a 10th grader. Exceptions to this are a district-level decision based on class size, enrollment numbers, student maturity, and CTE delivery method. This is a hands-on, lab- or shop-based course. Therefore, a maximum of 15 students is recommended per class with only one class with the teacher at a time.

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.

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 of the 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. **Fundamentals of Collision Repair—Course Code: 997102**
2. **Intermediate Painting and Refinishing—Course Code: 997103**
3. **Advanced Fundamentals of Collision Repair—Course Code: 997104**
4. **Advanced Painting and Refinishing—Course Code: 997105**

Course Description: Fundamentals of Collision Repair
This course contains information on safety, tool identification/use, employability skills, collision estimating, service specification and service information, measurement, personal/business finance, and damage analysis, estimating, and customer service.

Course Description: Intermediate Painting and Refinishing
This course contains information and skills relating to damage analysis, estimating and customer service, and painting and refinishing: surface preparations.

Course Description: Advanced Fundamentals of Collision Repair
This course contains information on safety, employee information, paint mixing/matching, business skills, advanced safety precautions and equipment, surface preparation, spray gun and related equipment, and paint mixing, matching, and applying.

Course Description: Advanced Painting and Refinishing
This course contains information and skills relating to paint defects, causes, and cures; final detail practices; and non-structural analysis and damage repair.

Fundamentals of Collision Repair—Course Code: 997102

Unit	Unit Name	Hours
1	Orientation	15
2	Workplace Employability Skills	10
3	Collision Repair Shop and Personal Safety	30
4	Tools and Equipment	25
5	Preparing a Vehicle for Service	30
6	Damage Analysis, Estimating, and Customer Service: Safety Precautions	15
7	Damage Analysis, Estimating, and Customer Service: Damage Analysis	15
Total		**140**

Intermediate Painting and Refinishing—Course Code: 997103

Unit	Unit Name	Hours
8	Damage Analysis, Estimating, and Customer Service: Estimating	15
9	Damage Analysis, Estimating, and Customer Service: Vehicle Construction and Parts Identification	25
10	Damage Analysis, Estimating, and Customer Service: Customer Relations and Sales Skills	20
11	Painting and Refinishing: Safety Precautions and Equipment I	20
12	Painting and Refinishing: Surface Preparation I	35
13	Painting and Refinishing: Spray Gun and Related Equipment Operation I	25
Total		**140**

Advanced Fundamentals of Collision Repair—Course Code: 997104

Unit	Unit Name	Hours
14	Orientation and Safety Review	10
15	Painting and Refinishing: Safety Precautions and Equipment II	15
16	Painting and Refinishing: Surface Preparation II	30
17	Painting and Refinishing: Spray Gun and Related Equipment Operation II	40
18	Painting and Refinishing: Paint Mixing, Matching, and Applying	45
Total		**140**

Advanced Painting and Refinishing—Course Code: 997105

Unit	Unit Name	Hours
19	Painting and Refinishing: Paint Defects—Causes and Cures	50
20	Painting and Refinishing: Final Detail	50
21	Basic Non-Structural Analysis and Damage Repair: Outer Body Panel Repairs, Replacements, and Adjustments	40
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. **Collision Repair Technician I—Course Code: 997100**
2. **Collision Repair Technician II—Course Code: 997101**

Course Description: Collision Repair Technician I
This course contains information on safety, tool identification/use, employee information, collision estimating, service specification and service information, measurement, personal/business finance, and damage analysis, estimating, and customer service

Course Description: Collision Repair Technician II
This course contains information on safety, tool identification/use, employee information, painting and refinishing, personal and business skills, and an introduction to non-structural analysis and damage repair.

Collision Repair Technician I—Course Code: 997100

Unit	Unit Name	Hours
1	Orientation	15
2	Workplace Employability Skills	10
3	Collision Repair Shop and Personal Safety	30
4	Tools and Equipment	25
5	Preparing a Vehicle for Service	30
6	Damage Analysis, Estimating, and Customer Service: Safety Precautions	15
7	Damage Analysis, Estimating, and Customer Service: Damage Analysis	15
8	Damage Analysis, Estimating, and Customer Service: Estimating	15
9	Damage Analysis, Estimating, and Customer Service: Vehicle Construction and Parts Identification	25
10	Damage Analysis, Estimating, and Customer Service: Customer Relations and Sales Skills	20
11	Painting and Refinishing: Safety Precautions and Equipment I	20
12	Painting and Refinishing: Surface Preparation I	35
13	Painting and Refinishing: Spray Gun and Related Equipment Operation I	25
Total		**280**

Collision Repair Technician II — Course Code: 997101

Unit	Unit Name	Hours
14	Orientation and Safety Review	10
15	Painting and Refinishing: Safety Precautions and Equipment II	15
16	Painting and Refinishing: Surface Preparation II	30
17	Painting and Refinishing: Spray Gun and Related Equipment Operation II	40
18	Painting and Refinishing: Paint Mixing, Matching, and Applying	45
19	Painting and Refinishing: Paint Defects—Causes and Cures	50
20	Painting and Refinishing: Final Detail	50
21	Basic Non-Structural Analysis and Damage Repair: Outer Body Panel Repairs, Replacements, and Adjustments	40
Total		**280**

Career Pathway Outlook

Overview
Information listed at the end of each course was considered during the revision process. The ASE Education Foundation content was especially useful in providing insight into trends and issues in the field. The references in Appendix A are suggested for use by instructors and students during the study of the topics outlined. Advisory team members throughout the state worked to revise the curriculum framework. Educators and industry indicate that the soft skills needed in this program include the following traits: maintaining a positive attitude, being at work every day and on time, and having reading and writing skills related to the collision repair field.

Needs of the Future Workforce
Data for this synopsis were compiled from the Mississippi Department of Employment Security (2018). Employment opportunities for each of the occupations listed below are:

Table 1.1: Current and Projected Occupation Report

Description	Jobs, 2018	Projected Jobs, 2028	Change (Number)	Change (Percent)	Average Hourly Earnings, 2021
Automotive Body and Related Repairers	1,140	1,140	0	0%	$20.63
Automotive Glass Installers and Repairers	170	170	0	0%	$16.93

Source: Mississippi Department of Employment Security; mdes.ms.gov (2021).

Perkins V Requirements and Academic Infusion
The collision repair technician curriculum meets Perkins V requirements of introducing students to and preparing them for high-skill, high-wage occupations in collision repair fields. It also offers students a program of study, including secondary, postsecondary, and institutions of higher learning courses, that will further prepare them for collision repair 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 collision repair 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 collision repair technician curriculum. SkillsUSA is an example of a student organization with many outlets for collision repair. Student organizations provide participants and members with growth opportunities and competitive events. They also open the doors to the world of collision repair 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 collision repair technician 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 collision repair technician curriculum provides opportunities for students to work together and help each other complete complex tasks. There are many field experiences within the collision repair technician curriculum that will allow and encourage collaboration with professionals currently in the collision repair field.

Work-Based Learning

Work-based learning is an extension of understanding competencies taught in the collision repair technician 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 collision repair professionals. Thus, supervised collaboration and immersion into the collision repair field around the students are keys to students' success, knowledge, and skills development.

Professional Organizations

Association for Career and Technical Education (ACTE)
acteonline.org

SkillsUSA
skillsusa.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 are 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. Teachers are welcome to teach the competencies in other ways than the listed objectives if it allows for mastery of the competencies. Teachers are also allowed to teach the units and competencies in the order that they prefer, as long as they teach necessary material allotted for that specific course or credit they are teaching at the time.

Teacher Resources
Teacher resources for this curriculum may be found in multiple places. Many program areas have teacher resource documents that accompany the curriculum and can be downloaded from the same site as the curriculum. The teacher resource document contains references, lesson ideas, websites, teaching and assessment strategies, scenarios, skills to master, and other resources divided by unit. This document could be updated periodically by RCU staff. Please check the entire document, including the entries for each unit, regularly for new information. If you have something you would like to add or have a question about the document, call or email the RCU's instructional design specialist for your program. The teacher resource document can be downloaded at rcu.msstate.edu/curriculum/curriculumdownload.aspx. All teachers should request to be added to the Canvas Resource Guide for their course. This is where all resources will be housed in the future if they are not already. 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
Many of the units include an enrichment section at the end. If the collision repair technician program is currently using the Mississippi Career Planning and Assessment System (MS-CPAS) as a measure of accountability, the enrichment section of material will not be tested. If this is the case, it is suggested to use the enrichment material when needed or desired by the teacher and if time allows in the class. This material will greatly enhance the learning experiences for students. If, however, the collision repair technician program is using a national certification or other measure of accountability that aligns with Perkins V as a quality indicator, this material could very well be tested. It is the responsibility of the teacher to ensure all competencies for the selected assessment are covered throughout the year.

Unit 1: Orientation

Competencies and Suggested Objectives
1. Describe local program and career and technical center policies and procedures. DOK1 a. Describe local program and career and technical center policies and procedures, including dress code, attendance, academic requirements, discipline, and transportation regulations.
2. Describe employment opportunities and responsibilities. DOK1 a. Describe employment opportunities, including potential earnings, employee benefits, job availability, place of employment, working conditions, and educational requirements. b. Describe basic employee responsibilities. c. Explain collision repair industry pay scales, including flat rate, salary, and hourly. d. Describe ASE certifications related to the collision repair industry.
3. Explore leadership skills and personal development opportunities provided by the student organization SkillsUSA. DOK1 a. Demonstrate effective team building and leadership skills. b. Practice appropriate work ethics. c. Explain the purpose, mission, objectives, motto, colors, official dress, and other distinguishing characteristics of SkillsUSA. d. Explain how participation in SkillsUSA can promote lifelong responsibility for community service, professional growth, and development. e. Explore the local, state, and national opportunities available to students through participation in SkillsUSA, including, but not limited to, conferences, competitions, community service, philanthropy, and other activities.

Unit 2: Workplace Employability Skills

Competencies and Suggested Objectives
1. Demonstrate the following personal standards. DOK1 a. Report to work on time daily, ready to take directions and demonstrate motivation to accomplish the task at hand. b. Dress appropriately and use language and manners suitable for the workplace. c. Maintain personal hygiene appropriate to the workplace. d. Meet and maintain employment eligibility criteria such as drug/alcohol-free status, clean driving record, and so forth. e. Demonstrate honesty, integrity, and reliability.
2. Demonstrate the ability to follow verbal and written instructions and communicate effectively in on-the-job situations. DOK2 a. Comply with workplace policies/laws. b. Contribute to the success of the team, assist others, and request help when needed. c. Work well with all customers and coworkers. d. Negotiate solutions to interpersonal and workplace conflicts. e. Contribute ideas and demonstrate initiative. f. Follow directions. g. Communicate (written and verbally) effectively with customers and coworkers. h. Read and interpret workplace documents. Write clearly and concisely. i. Analyze and resolve problems that arise in completing assigned tasks. j. Organize and implement a productive plan of work. k. Use scientific, technical, engineering and mathematics principles and reasoning to accomplish assigned tasks. l. Identify and address the needs of all customers. Provide helpful, courteous, and knowledgeable service and advice as needed. m. Communicate effectively with customers, colleagues, and employers to include conflict resolution.

Unit 3: Collision Repair Shop and Personal Safety

Competencies and Suggested Objectives
1. Identify and describe general safety rules. DOK1 a. Identify general shop safety rules and procedures. b. Utilize safe procedures for handling of tools and equipment. c. Identify and use proper placement of floor jacks and jack stands. d. Identify and use proper procedures for safe lift operation. e. Utilize proper ventilation procedures for working within the lab/shop area. f. Identify marked safety areas. g. Identify the location and the types of fire extinguishers and other fire safety equipment. h. Demonstrate knowledge of the procedures for using fire extinguishers and other fire safety equipment. i. Identify the location and use of eyewash stations. j. Identify the location of the posted evacuation routes. k. Comply with the required use of safety glasses, ear protection, gloves, and shoes during lab/shop activities. l. Identify and wear appropriate clothing for lab/shop activities. m. Secure hair and jewelry for lab/shop activities. n. Demonstrate awareness of the safety aspects of supplemental restraint systems (SRS), electronic brake control systems, and hybrid vehicle high-voltage circuits. o. Demonstrate awareness of the safety aspects of high-voltage circuits (e.g., high-intensity discharge [HID] lamps, ignition systems, injection systems, etc.). p. Locate and demonstrate knowledge of safety data sheets (SDS). q. Identify and explain the procedures for lifting heavy objects.

Note: Safety is to be taught as an ongoing part of the program. Students are required to complete a written safety test with 100% accuracy before entering the shop for lab simulations and projects. This test should be documented in each student's file.

Unit 4: Tools and Equipment

Competencies and Suggested Objectives
1. Explore tools and equipment used in the collision repair service industry. DOK1 a. Identify tools and their usage in collision applications. b. Identify standard and metric designation. c. Demonstrate safe handling and use of appropriate tools. d. Demonstrate proper cleaning, storage, and maintenance of tools and equipment. e. Demonstrate proper use of precision measuring tools (e.g., micrometer, dial indicator, dial caliper).

Note: This unit will be ongoing throughout the year. Time allotted for this unit will be distributed over the entire year.

Unit 5: Preparing a Vehicle for Service

Competencies and Suggested Objectives
1. Explore the procedures for preparing a vehicle for collision repair service. DOK2 a. Review the damage report and analyze the damage to determine appropriate methods for overall repair. Develop and document a repair plan. b. Inspect, remove, protect, label, store, inventory, and reinstall exterior trim and moldings. c. Inspect, remove, protect, label, store, inventory, and reinstall interior trim and components. d. Inspect, remove, protect, label, store, inventory, and reinstall body panels and components that may interfere with or be damaged during repair. e. Inspect, remove, protect, label, store, inventory, and reinstall vehicle mechanical and electrical components that may interfere with or be damaged during repair. f. Protect panels, glass, interior parts, and other vehicles adjacent to the repair area. g. Soap and water wash the entire vehicle and complete the pre-repair inspection checklist. h. Prepare the damaged area using water-based and solvent-based cleaners. i. Remove corrosion protection, undercoating, sealers, and other protective coatings as necessary to perform repairs. j. Inspect, remove, and reinstall repairable plastics and other components for off-vehicle repair.

Unit 6: Damage Analysis, Estimating, and Customer Service: Safety Precautions

Competencies and Suggested Objectives
1. Identify and describe safety precautions. DOK2 a. Select and use proper personal safety equipment. Take necessary precautions with hazardous operations and materials in accordance with federal, state, and local regulations. b. Locate original equipment manufacturer (OEM) procedures to identify material and composition of the vehicle being repaired (e.g., mild steel, high strength steel, ultra-high strength steel, aluminum, etc.). c. Locate procedures and precautions that may apply to the vehicle being repaired. d. Identify vehicle system precautions and/or inspections to include, but not limited to, SRS, advanced driver assistance systems (ADAS), hybrid/electric/alternative fuel vehicles, locations and recommended procedures before inspecting or replacing components. e. Perform vehicle clean-up. Complete quality control using a checklist on operations performed.

Note: Safety is to be taught as an ongoing part of the program. Students are required to complete a written safety test with 100% accuracy before entering the shop for lab simulations and projects. This test should be documented in each student's file.

Unit 7: Damage Analysis, Estimating, and Customer Service: Damage Analysis

Competencies and Suggested Objectives
1. Identify and describe damage analysis. DOK 2 a. Position the vehicle for inspection under proper lighting. Take photos to identify the vehicle and document damage. b. Identify components to be removed to gain access to damaged areas. c. Analyze damage to determine appropriate methods for overall repairs. d. Determine the direction, point(s) of impact, and extent of direct, indirect, and inertia damage. e. Gather details of the incident/accident necessary to determine the full extent of the vehicle damage. f. Identify and record preexisting damage. g. Identify and record prior repairs. h. Perform a visual inspection of structural components. i. Identify structural damage using measuring tools and equipment. j. Perform a visual inspection of non-structural components. k. Determine parts, components, material type(s), and procedures necessary for a proper repair. l. Identify the type and condition of the finish. Determine refinish labor operations as required. m. Identify suspension, electrical, and mechanical component physical damage. n. Identify safety systems physical damage. o. Identify interior component damage. p. Identify add-on accessories and modifications. q. Identify single-use (i.e., one-time use) components. r. Identify and document illuminated dash malfunction indicator lamp(s) (MIL). s. Perform a pre-repair inspection of the vehicle with the customer. Record fit and finish concerns (e.g., color mismatch, factory gaps, unrelated prior damage, prior repairs, etc.).

Unit 8: Damage Analysis, Estimating, and Customer Service: Estimating

Competencies and Suggested Objectives
1. Discuss and apply estimating processes. DOK2 a. Determine and record customer/vehicle owner information. b. Identify and record vehicle identification number (VIN) information, including nation of origin, make, model, restraint system, body type, production date, engine type, build data, and assembly plant. c. Identify and record vehicle mileage and options, including trim level, paint code, transmission, accessories, and modifications. d. Identify safety systems. Determine precautions, inspections, and replacement items as required. e. Apply appropriate estimating and parts nomenclature (i.e., terminology). f. Determine and apply the appropriate estimating sequence. g. Utilize estimating procedure pages. h. Apply estimating footnotes, headnotes, and line notes as needed. i. Identify operations requiring labor value judgment. j. Select the appropriate labor code for each operation (e.g., structural, non-structural, mechanical, and refinish). k. Select and price OEM parts; optional OEM parts, aftermarket parts, recyclable/used parts, remanufactured, rebuilt, and reconditioned parts. Verify availability, compatibility, and condition. l. Determine necessary sublet operations. m. Determine included and non-included operations and miscellaneous items. n. Recognize and apply overlap deductions. o. Determine additional material and charges. p. Determine refinishing material and charges. q. Apply math skills to establish charges and totals. r. Identify differences between computer generated and manually written estimates. s. Identify procedures to restore corrosion protection. Establish labor values and material charges. t. Recognize the cost effectiveness of the repair and determine the approximate vehicle retail and repair value. u. Recognize the differences in estimating platforms when using different information provider systems. v. Verify the accuracy of the estimate compared to the actual repair and replacement operations.

w. Determine the telematic/connectivity of the vehicle and place the vehicle in service mode.
x. Identify vehicle safety recalls using the VIN.
y. Review the damage report and analyze the damage to determine appropriate methods for overall repair. Communicate with team members to verify accuracy and resolve discrepancies.

Unit 9: Damage Analysis, Estimating, and Customer Service: Vehicle Construction and Parts Identification

Competencies and Suggested Objectives
1. Discuss vehicle construction and parts identification. DOK2 a. Identify the type of vehicle construction (e.g., unibody, body-over-frame). b. Recognize the different collision damage between unibody and body-over-frame vehicles. c. Identify impact energy-absorbing components. d. Identify different types of substrates (e.g., steel types, aluminum, magnesium, plastic, composites, etc.). Determine repairability. e. Identify vehicle glass components and repair/replacement procedures. f. Identify add-on accessories.

Unit 10: Damage Analysis, Estimating, and Customer Service: Customer Relations and Sales Skills

Competencies and Suggested Objectives
1. Discuss customer relations and sales skills. DOK2 a. Introduce yourself and acknowledge and greet the customer/client/visitor. Offer assistance. b. Listen to the customer/client, collect information, and identify customer's/client's concerns, needs, and expectations. c. Establish a cooperative attitude with the customer/client. d. Deal with a dissatisfied customer/client. Seek resolution. e. Identify the customer's/client's preferred communication method. Follow up to keep the customer/client informed about parts and the repair process. f. Recognize basic claims handling procedures. Explain the procedures to the customer/client. g. Project a positive attitude and professional appearance. h. Provide and review warranty information. i. Provide and review technical and consumer protection information. j. Estimate and explain the duration of out-of-service time. k. Demonstrate negotiation skills to obtain a mutual agreement. l. Interpret and explain the estimate to the customer/client.

Unit 11: Painting and Refinishing: Safety Precautions and Equipment I

Competencies and Suggested Objectives
1. Introduce general safety rules for working in a shop/lab and industry. DOK 2 a. Select and use the proper personal safety equipment for surface preparation; spray gun and related equipment operation; paint mixing, matching, and application; paint defects; and detailing (e.g., gloves, suits, hoods, eye and ear protection, etc.). Take necessary precautions with hazardous operations and materials according to federal, state, and local regulations. b. Identify safety and personal health hazards according to Occupational Safety and Health Administration (OSHA) guidelines and the "Right to Know Law." c. Inspect the spray environment and equipment to ensure compliance with federal, state, and local regulations and for safety and cleanliness hazards. d. Select and use a National Institute for Occupational Safety and Health (NIOSH)-approved supplied air (Fresh Air Make-up) respirator system. Perform proper maintenance in accordance with OSHA Regulation 1910.134 and applicable state and local regulations. e. Perform vehicle clean-up. Complete quality control using a checklist on operations performed.
2. Review proper use and care for shop equipment related to the collision repair industry. DOK2

Unit 12: Painting and Refinishing: Surface Preparation I

Competencies and Suggested Objectives
1. Explain procedures as they pertain to surface preparation. DOK 2 a. Inspect, remove, store, protect, and replace exterior trim and components necessary for proper surface preparation. b. Soap and water wash the entire vehicle. Use the appropriate cleaner to remove contaminants. c. Inspect and identify the type of finish, surface condition, and film thickness. Develop and document a plan for refinishing using a total product system. d. Remove the paint finish as needed. e. Properly sand the areas to be refinished. f. Identify and select the appropriate sandpaper to featheredge the areas to be refinished. g. Apply a suitable metal treatment or primer in accordance with total product systems. h. Mask and protect other areas that will not be refinished. i. Demonstrate different masking techniques (e.g., recess/back masking, foam door type, etc.). j. Mix primer, primer-surfacer, and primer-sealer following paint manufacturers' technical data sheet instructions. k. Identify a complimentary color or shade of undercoat to improve coverage. l. Apply primer to the surface of a repaired area, demonstrating control of primer application by keeping the area as small as possible. m. Apply two-component finishing filler to minor surface imperfections. n. Guide coat and block sand the area with the correct grade/grit sandpaper to which primer-surfacer has been applied. o. Dry sand the area to which two-component finishing filler has been applied. p. Remove dust from the area to be refinished, including cracks or moldings of adjacent areas. q. Clean the area to be refinished using a recommended final cleaning solution. r. Remove, with a tack rag, any dust or lint particles from the area to be refinished. s. Apply a suitable primer-sealer to the area being refinished. t. Scuff sand to remove nibs or imperfections from a sealer. u. Apply a stone chip-resistant coating. v. Restore caulking and seam sealers to repaired areas and replacement panels as required. w. Prepare adjacent panels for blending using paint manufacturers' procedures. x. Identify the types of rigid, semi-rigid, or flexible plastic parts to be refinished. Determine the materials needed and the preparation and refinishing procedures.

y. Identify metal parts to be refinished. Determine the materials needed and the preparation and refinishing procedures.
z. Identify chip-resistant coatings and texture match.
aa. Identify caulking and seal sealers that may need replacement.
bb. Identify refinishing guidelines for stationary glass flange areas to be refinished.

Unit 13: Painting and Refinishing: Spray Gun and Related Equipment Operation I

Competencies and Suggested Objectives
1. Evaluate and perform procedures as they pertain to spray gun and related equipment operation. DOK 2 a. Inspect, clean, and determine the condition of spray guns and related equipment (e.g., air hoses, regulators, air lines, air source, spray environment, and fillers). b. Select a spray gun setup for the product being applied (e.g., fluid needle, nozzle, cap). c. Test and adjust a spray gun using fluid, air, and pattern control valves. d. Demonstrate an understanding of the operation of pressure spray equipment.

Unit 14: Orientation and Safety Review

Competencies and Suggested Objectives
1. Describe local program and career and technical center policies and procedures. DOK1 a. Describe local program and career and technical center policies and procedures, including dress code, attendance, academic requirements, discipline, and transportation regulations.
2. Describe employment opportunities and responsibilities. DOK1 a. Describe employment opportunities, including potential earnings, employee benefits, job availability, place of employment, working conditions, and educational requirements. b. Describe basic employee responsibilities. c. Design a résumé and letter of application and complete a job application. d. Explain collision repair industry pay scales, including flat rate, salary and hourly. e. Describe ASE certifications related to the collision repair industry.
3. Explore leadership skills and personal development opportunities provided by the student organization SkillsUSA. DOK1 a. Demonstrate effective team building and leadership skills. b. Practice appropriate work ethics. c. Explain the purpose, mission, objectives, motto, colors, official dress, and other distinguishing characteristics of SkillsUSA. d. Explain how participation in SkillsUSA can promote lifelong responsibility for community service, professional growth, and development. e. Explore the local, state, and national opportunities available to students through participation in SkillsUSA, including, but not limited to, conferences, competitions, community service, philanthropy, and other activities.
4. Describe general safety rules for working in a shop/lab and industry. DOK2 a. Discuss safety issues and prevention associated with the collision repair shop area. b. Explain fire safety and prevention in the workplace.

Note: Safety is to be taught as an ongoing part of the program. Students are required to complete a written safety test with 100% accuracy before entering the shop for lab simulations and projects. This test should be documented in each student's file.

Unit 15: Painting and Refinishing: Safety Precautions and Equipment II

Competencies and Suggested Objectives
1. Introduce general safety rules for working in a shop/lab and industry. DOK 2 a. Select and use the proper personal safety equipment for surface preparation; spray gun and related equipment operation; paint mixing, matching, and application; paint defects; and detailing (e.g., gloves, suits, hoods, eye and ear protection, etc.). Take necessary precautions with hazardous operations and materials according to federal, state, and local regulations. b. Identify safety and personal health hazards according to OSHA guidelines and the "Right to Know Law." c. Inspect the spray environment and equipment to ensure compliance with federal, state, and local regulations and for safety and cleanliness hazards. d. Select and use a NIOSH-approved supplied air (Fresh Air Make-up) respirator system. Perform proper maintenance in accordance with OSHA Regulation 1910.134 and applicable state and local regulations. e. Perform vehicle clean-up. Complete quality control using a checklist on operations performed.
2. Review proper use and care for shop equipment related to the collision repair industry. DOK 2

Note: Safety is to be taught as an ongoing part of the program. Students are required to complete a written safety test with 100% accuracy before entering the shop for lab simulations and projects. This test should be documented in each student's file.

Unit 16: Painting and Refinishing: Surface Preparation II

Competencies and Suggested Objectives
1. Explain procedures as they pertain to surface preparation. DOK 2 a. Inspect, remove, store, protect, and replace exterior trim and components necessary for proper surface preparation. b. Soap and water wash the entire vehicle. Use the appropriate cleaner to remove contaminants. c. Inspect and identify the type of finish, surface condition, and film thickness. Develop and document a plan for refinishing using a total product system. d. Remove the paint finish as needed. e. Properly sand the areas to be refinished. f. Identify and select the appropriate sandpaper to featheredge the areas to be refinished. g. Apply a suitable metal treatment or primer in accordance with total product systems. h. Mask and protect other areas that will not be refinished. i. Demonstrate different masking techniques (e.g., recess/back masking, foam door type, etc.). j. Mix primer, primer-surfacer, and primer-sealer, following paint manufacturers' technical data sheet instructions. k. Identify a complimentary color or shade of undercoat to improve coverage. l. Apply primer to the surface of a repaired area, demonstrating control of primer application by keeping the area as small as possible. m. Apply two-component finishing filler to minor surface imperfections. n. Guide coat and block sand the area with the correct grade/grit sandpaper to which primer-surfacer has been applied. o. Dry sand the area to which two-component finishing filler has been applied. p. Remove dust from the area to be refinished, including cracks or moldings of adjacent areas. q. Clean the area to be refinished using a recommended final cleaning solution. r. Remove, with a tack rag, any dust or lint particles from the area to be refinished. s. Apply a suitable primer-sealer to the area being refinished. t. Scuff sand to remove nibs or imperfections from a sealer. u. Apply a stone chip-resistant coating. v. Restore caulking and seam sealers to repaired areas and replacement panels as required. w. Prepare adjacent panels for blending using paint manufacturers' procedures. x. Identify the types of rigid, semi-rigid, or flexible plastic parts to be refinished. Determine the materials needed and the preparation and refinishing procedures.

y. Identify metal parts to be refinished. Determine the materials needed and the preparation and refinishing procedures.
z. Identify chip-resistant coatings and texture match.
aa. Identify caulking and seal sealers that may need replacement.
bb. Identify refinishing guidelines for stationary glass flange areas to be refinished.

Unit 17: Painting and Refinishing: Spray Gun and Related Equipment Operation II

Competencies and Suggested Objectives
1. Evaluate and perform procedures as they pertain to spray gun and related equipment operation. DOK 2 a. Inspect, clean, and determine the condition of spray guns and related equipment (e.g., air hoses, regulators, air lines, air source, spray environment, and fillers). b. Select a spray gun setup for the product being applied (e.g., fluid needle, nozzle, cap). c. Test and adjust a spray gun using fluid, air, and pattern control valves. d. Demonstrate an understanding of the operation of pressure spray equipment.

Unit 18: Painting and Refinishing: Paint Mixing, Matching, and Applying

Competencies and Suggested Objectives
1. Introduce and discuss procedures as they pertain to the skills of paint mixing, matching, and applying. DOK2 a. Identify the color code by the manufacturer's vehicle information label. b. Shake, stir, reduce, catalyze/activate, and strain refinish materials. c. Apply finish using the appropriate spray techniques for the finish being applied (e.g., gun arc, angle, distance, travel speed, spray pattern overlap). d. Apply a selected product on a test or let-down panel. Check for a color match, properly store and maintain a color catalog. e. Understand the application of single-stage topcoats. f. Apply a basecoat/clearcoat for panel blending, panel refinishing, and cut-ins. g. Apply a basecoat/clearcoat for overall refinishing. h. Remove nibs or imperfections from a basecoat. i. Identify product expiration dates as applicable. j. Refinish plastic parts. k. Apply multi-stage coats for panel blending and overall refinishing. l. Identify and mix paint using a formula. m. Identify poor hiding colors. Determine the necessary action. n. Tint color using a formula to achieve a blendable match. o. Identify an alternative color formula to achieve a blendable match. p. Identify the materials, equipment, and preparation differences between solvent and waterborne technologies.

Unit 19: Painting and Refinishing: Paint Defects—Causes and Cures

Competencies and Suggested Objectives

1. Evaluate and perform procedures as they pertain to paint defects. DOK 2
   a. Identify blistering (i.e., raising of the paint surface, air entrapment). Correct the cause(s) and the condition.
   b. Identify a dry spray appearance in the paint surface. Correct the cause(s) and the condition.
   c. Identify the presence of fish-eyes (i.e., crater-like openings) in the finish. Correct the cause(s) and the condition.
   d. Identify lifting. Correct the cause(s) and the condition.
   e. Identify clouding (i.e., mottling and streaking in metallic finishes). Correct the cause(s) and the condition.
   f. Identify orange peel. Correct the cause(s) and the condition.
   g. Identify overspray. Correct the cause(s) and the condition.
   h. Identify solvent popping in a freshly painted surface. Correct the cause(s) and the condition.
   i. Identify sags and runs in a paint surface. Correct the cause(s) and the condition.
   j. Identify sanding marks or sand scratch swelling. Correct the cause(s) and the condition.
   k. Identify contour mapping/edge mapping. Correct the cause(s) and the condition.
   l. Identify color difference (off-shade). Correct the cause(s) and the condition.
   m. Identify tape tracking. Correct the cause(s) and the condition.
   n. Identify low-gloss condition. Correct the cause(s) and the condition.
   o. Identify poor adhesion. Correct the cause(s) and the condition.
   p. Identify paint cracking (e.g., shrinking, splitting, crowsfeet or line-checking, micro-checking, etc.). Correct the cause(s) and the condition.
   q. Identify corrosion. Correct the cause(s) and the condition.
   r. Identify dirt or dust in the paint surface. Correct the cause(s) and the condition.
   s. Identify water spotting. Correct the cause(s) and the condition.
   t. Identify finish damage caused by bird droppings, tree sap, and other natural causes. Correct the condition.
   u. Identify finish damage caused by airborne contaminants (e.g., acids, soot, rail dust, and other industrial-related causes). Correct the condition.
   v. Identify die-back conditions (i.e., dulling of the paint film showing haziness). Correct the cause(s) and the condition.
   w. Identify chalking (i.e., oxidation). Correct the cause(s) and the condition.
   x. Identify bleed-through (i.e., staining). Correct the cause(s) and the condition.
   y. Identify pinholing. Correct the cause(s) and the condition.

z. Identify buffing-related imperfections (e.g., swirl marks, wheel burns). Correct the condition.

aa. Identify pigment flotation (i.e., color change through film build). Correct the cause(s) and the condition.

Unit 20: Painting and Refinishing: Final Detail

Competencies and Suggested Objectives
1. Evaluate and perform procedures as they pertain to final detail. DOK 2 a. Apply decals, transfers, tapes, stone guards, moldings, emblems, and so forth. b. Sand, buff, and polish fresh finish to remove defects and texture as required. c. Sand, buff, and polish existing finish to recondition defects as required and match the existing finish. d. Clean the interior, exterior, and glass. e. Clean body openings (e.g., door jambs, gaps, edges, etc.). f. Remove overspray. g. Perform vehicle clean-up. Complete quality control using a checklist. h. Measure and record film thickness before and after buffing. i. Perform nib sanding to remove small imperfections as required.

Unit 21: Basic Non-Structural Analysis and Damage Repair: Outer Body Panel Repairs, Replacements, and Adjustments

Competencies and Suggested Objectives
1. Inspect, analyze, perform, and evaluate procedures and skills pertaining to outer body panel repairs, replacements, and adjustments. DOK2 a. Inspect/locate direct, indirect, or hidden damage and the direction of impact. b. Inspect, remove, and replace the welded steel panel or panel assemblies. c. Determine the extent of damage to aluminum body panels and repair or replace. d. Inspect, remove, replace, and align a hood, hood hinges, and hood latch. e. Inspect, remove, replace, and align a deck lid, lid hinges, and lid latch. f. Inspect, remove, replace, and align doors, latches, hinges, and related hardware. g. Inspect, remove, replace, and align tailgates, hatches, liftgates, and sliding doors. h. Inspect, remove, replace, overhaul, and align bumpers, covers, reinforcements, guards, impact absorbers, and mounting hardware. i. Inspect, remove, replace, and align fenders and related panels. j. Restore corrosion protection during and after the repair. k. Replace door skins. l. Restore sound deadeners and foam materials. m. Perform panel bonding and weld bonding. n. Diagnose and repair water leaks, dust leaks, and wind noise. o. Identify one-time use fasteners. p. Weld damaged or torn steel body panels and repair broken welds. q. Inspect and identify labels/decals and replace as necessary.

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, which are the tasks that are necessary to be mastered to pass the national certification. It can be duplicated for each student, and it can serve as a cumulative record of competencies achieved in the course.

Student's degree of competency will be noted using the following scale:

5 Mastered competencies. Able to perform all elements of the task successfully and independently without supervision.
4 Satisfactory performance of task. Acceptable performance of all elements of task with mastery of some elements.
3 Capable of performing task adequately, but some elements need improvement.
2 Satisfactory performance of some elements of task and unsatisfactory performance of some elements of task.
1 Unsatisfactory performance of task.
0 **Student missed task**

Collision Repair Technician: Units 1, 3, and 4		
Orientation		
	1.	Describe local program and career and technical center policies and procedures.[DOK1].
	2.	Describe employment opportunities and responsibilities. [DOK1]
	3.	Explore leadership skills and personal development opportunities provided by the student organization SkillsUSA. [DOK1]
Collision Repair Shop and Personal Safety		
	1.	Identify and describe general safety rules. [DOK1]
Tools and Equipment		
	1.	Explore tools and equipment used in the collision repair service industry. [DOK1]

Required Supplemental Tasks: ASE Collision Standards			
Workplace Employability Skills			
Personal Standards (Standard 7.9)			
	1.	Report to work on time daily, ready to take directions and demonstrate motivation to accomplish the task at hand.	
	2.	Dress appropriately and use language and manners suitable for the workplace.	
	3.	Maintain personal hygiene appropriate to the workplace.	
	4.	Meet and maintain employment eligibility criteria such as drug/alcohol-free status, clean driving record, and so forth.	
	5.	Demonstrate honesty, integrity, and reliability.	
Work Habits/Ethic (Standards 7.10)			
	1.	Comply with workplace policies/laws.	
	2.	Contribute to the success of the team, assist others, and request help when needed.	
	3.	Work well with all customers and coworkers.	
	4.	Negotiate solutions to interpersonal and workplace conflicts.	
	5.	Contribute ideas and demonstrate initiative.	
	6.	Follow directions.	
	7.	Communicate (written and verbally) effectively with customers and coworkers.	
	8.	Read and interpret workplace documents. Write clearly and concisely.	
	9.	Analyze and resolve problems that arise in completing assigned tasks.	
	10.	Organize and implement a productive plan of work.	
	11.	Uses scientific, technical, engineering, and mathematics principles and reasoning to accomplish assigned tasks.	
	12.	Identify and address the needs of all customers. Provide helpful, courteous, and knowledgeable service and advice as needed.	
	13.	Respect tools and property used in a school and workplace environment.	

Damage Analysis, Estimating, and Customer Service			
For every task in Damage Analysis, Estimating and Customer Service, the following safety requirements must be strictly enforced: Comply with personal and environmental safety practices associated with clothing and proper personal protection equipment (PPE); hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations. Identify vehicle system precautions and/or inspections to include, but not limited to, supplemental restraint system (SRS) inspection, advanced driver assistance systems (ADAS), hybrid/electric/alternative fuel vehicles, locations, and recommended procedures before inspecting or replacing components.			
A. Safety Precautions			
	1.	Select and use proper personal safety equipment. Take necessary precautions with hazardous operations and materials in accordance with federal, state, and local regulations.	
	2.	Locate original equipment manufacturer (OEM) procedures to identify material and composition of the vehicle being repaired (e.g., mild steel, high strength steel, ultra-high strength steel, aluminum, etc.).	
	3.	Locate procedures and precautions that may apply to the vehicle being repaired.	
	4.	Identify vehicle system precautions and/or inspections to include, but not limited to, (SRS), advanced driver assistance systems (ADAS), hybrid/electric/alternative fuel vehicles, locations, and recommended procedures before inspecting or replacing components.	
	5.	Perform vehicle clean-up. Complete quality control using a checklist on operations performed.	
B. Damage Analysis			
	1.	Position the vehicle for inspection under proper lighting. Take photos to identify the vehicle and document damage.	
	2.	Identify components to be removed to gain access to damaged areas.	
	3.	Analyze damage to determine appropriate methods for overall repairs.	
	4.	Determine the direction, point(s) of impact, and extent of direct, indirect, and inertia damage.	
	5.	Gather details of the incident/accident necessary to determine the full extent of vehicle damage.	

	6.	Identify and record pre-existing damage.	
	7.	Identify and record prior repairs.	
	8.	Perform a visual inspection of structural components.	
	9	Identify structural damage using measuring tools and equipment.	
	10.	Perform a visual inspection of non-structural components.	
	11.	Determine parts, components, material type(s), and procedures necessary for a proper repair.	
	12.	Identify the type and condition of the finish. Determine refinish labor operations as required.	
	13.	Identify suspension, electrical, and mechanical component physical damage.	
	14.	Identify safety systems physical damage.	
	15.	Identify interior component damage.	
	16.	Identify add-on accessories and modifications.	
	17.	Identify single-use (i.e., one-time use) components.	
	18.	Identify and document illuminated dash malfunction indicator lamp(s) (MIL).	
	19.	Perform a pre-repair inspection of the vehicle with the customer. Record fit and finish concerns (e.g., color mismatch, factory gaps, unrelated prior damage, prior repairs, etc.).	
C. Estimating			
	1.	Determine and record customer/vehicle owner information.	
	2.	Identify and record vehicle identification number (VIN) information, including nation of origin, make, model, restraint system, body type, production date, engine type, build data, and assembly plant.	
	3.	Identify and record vehicle mileage and options, including trim level, paint code, transmission, accessories, and modifications.	
	4.	Identify safety systems. Determine precautions, inspections, and replacement items as required.	
	5.	Apply appropriate estimating and parts nomenclature (i.e., terminology).	
	6.	Determine and apply the appropriate estimating sequence.	
	7.	Utilize estimating procedure pages.	
	8.	Apply estimating footnotes, headnotes, and line notes as needed.	

	9.	Identify operations requiring labor value judgment.	
	10.	Select the appropriate labor code for each operation (e.g., structural, non-structural, mechanical, and refinish).	
	11.	Select and price OEM parts; optional OEM parts, aftermarket parts, recyclable/used parts, remanufactured, rebuilt, and reconditioned parts. Verify availability, compatibility, and condition.	
	12.	Determine necessary sublet operations.	
	13.	Determine included and non-included operations and miscellaneous items.	
	14.	Recognize and apply overlap deductions.	
	15.	Determine additional material and charges.	
	16.	Determine refinishing material and charges.	
	17.	Apply math skills to establish charges and totals.	
	18.	Identify differences between computer generated and manually written estimates.	
	19.	Identify procedures to restore corrosion protection. Establish labor values and material charges.	
	20.	Recognize the cost effectiveness of the repair and determine the approximate vehicle retail and repair value.	
	21.	Recognize the differences in estimating platforms when using different information provider systems.	
	22.	Verify the accuracy of the estimate compared to the actual repair and replacement operations.	
	23.	Determine the telematic/connectivity of the vehicle and place the vehicle in service mode.	
	24.	Identify vehicle safety recalls using the VIN.	
	25.	Review the damage report and analyze the damage to determine appropriate methods for overall repair. Communicate with team members to verify accuracy and resolve discrepancies.	
D. Vehicle Construction and Parts Identification			
	1.	Identify the type of vehicle construction (e.g., unibody, body-over-frame).	
	2.	Recognize the different collision damage between unibody and body-over-frame vehicles.	
	3.	Identify impact energy-absorbing components.	

	4.	Identify different types of substrates (e.g., steel types, aluminum, magnesium, plastic, composites, etc.). Determine repairability.	
	5.	Identify vehicle glass components and repair/replacement procedures.	
	6.	Identify add-on accessories.	
E. Customer Relations and Sales Skills			
	1.	Introduce yourself and acknowledge and greet the customer/client/visitor. Offer assistance.	
	2.	Listen to the customer/client, collect information, and identify customer's/client's concerns, needs, and expectations.	
	3.	Establish a cooperative attitude with the customer/client.	
	4.	Deal with a dissatisfied customer/client. Seek resolution.	
	5.	Identify the customer's/client's preferred communication method. Follow up to keep the customer/client informed about parts and the repair process.	
	6.	Recognize basic claims handling procedures. Explain the procedures to the customer/client.	
	7.	Project a positive attitude and professional appearance.	
	8.	Provide and review warranty information.	
	9.	Provide and review technical and consumer protection information.	
	10.	Estimate and explain the duration of out-of-service time.	
	11.	Demonstrate negotiation skills to obtain a mutual agreement.	
	12.	Interpret and explain the estimate to the customer/client.	

Paint and Refinishing			
For every task in Painting and Refinishing, the following safety requirements must be strictly enforced: Comply with personal and environmental safety practices associated with clothing and proper PPE); hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations. Identify vehicle system precautions and/or inspections to include, but not limited to, SRS ADAS, hybrid/electric/alternative fuel vehicles, locations and recommended procedures before inspecting or replacing components.			
A. Safety Precautions			
	1.	Select and use the proper personal safety equipment for surface preparation; spray gun and related equipment operation; paint mixing, matching, and application; paint defects; and detailing (e.g., gloves, suits, hoods, eye and ear protection, etc.). Take necessary precautions with hazardous operations and materials according to federal, state, and local regulations.	
	2.	Identify safety and personal health hazards according to Occupational Safety and Health Administration (OSHA) guidelines and the "Right to Know Law."	
	3.	Inspect the spray environment and equipment to ensure compliance with federal, state and local regulations and for safety and cleanliness hazards.	
	4.	Select and use a National Institute for Occupational Safety and Health (NIOSH)-approved supplied air (Fresh Air Make-up) respirator system. Perform proper maintenance in accordance with OSHA Regulation 1910.134 and applicable state and local regulations.	
	5.	Perform vehicle clean-up. Complete quality control using a checklist on operations performed.	
B. Surface Preparation			
	1.	Inspect, remove, store, protect, and replace exterior trim and components necessary for proper surface preparation.	
	2.	Soap and water wash the entire vehicle. Use the appropriate cleaner to remove contaminants.	
	3.	Inspect and identify the type of finish, surface condition, and film thickness. Develop and document a plan for refinishing using a total product system.	
	4.	Remove the paint finish as needed.	
	5.	Properly sand the areas to be refinished.	
	6.	Identify and select the appropriate sandpaper to featheredge the areas to be refinished.	

	7.	Apply a suitable metal treatment or primer in accordance with total product systems.	
	8.	Mask and protect other areas that will not be refinished.	
	9.	Demonstrate different masking techniques (e.g., recess/back masking, foam door type, etc.).	
	10.	Mix primer, primer-surfacer, and primer-sealer following paint manufacturers' technical data sheet instructions.	
	11.	Identify a complimentary color or shade of undercoat to improve coverage.	
	12.	Apply primer to the surface of a repaired area, demonstrating control of primer application by keeping the area as small as possible.	
	13.	Apply two-component finishing filler to minor surface imperfections.	
	14.	Guide coat and block sand the area with the correct grade/grit sandpaper to which primer-surfacer has been applied.	
	15.	Dry sand the area to which two-component finishing filler has been applied.	
	16.	Remove dust from the area to be refinished, including cracks or moldings of adjacent areas.	
	17.	Clean the area to be refinished using a recommended final cleaning solution.	
	18.	Remove, with a tack rag, any dust or lint particles from the area to be refinished.	
	19.	Apply a suitable primer-sealer to the area being refinished.	
	20.	Scuff sand to remove nibs or imperfections from a sealer.	
	21.	Apply a stone chip-resistant coating.	
	22.	Restore caulking and seam sealers to repaired areas and replacement panels as required.	
	23.	Prepare adjacent panels for blending using paint manufacturers' procedures.	
	24.	Identify the types of rigid, semi-rigid, or flexible plastic parts to be refinished. Determine the materials needed and the preparation and refinishing procedures.	
	25.	Identify metal parts to be refinished. Determine the materials needed and the preparation and refinishing procedures.	
	26.	Identify chip-resistant coatings and texture match.	
	27.	Identify caulking and seal sealers that may need replacement.	

	28.	Identify refinishing guidelines for stationary glass flange areas to be refinished.	
C. Spray Gun and Related Equipment Operation			
	1.	Inspect, clean, and determine the condition of spray guns and related equipment (e.g., air hoses, regulators, air lines, air source, spray environment, fillers).	
	2.	Select a spray gun setup for the product being applied (e.g., fluid needle, nozzle, cap).	
	3.	Test and adjust a spray gun using fluid, air, and pattern control valves.	
	4.	Demonstrate an understanding of the operation of pressure spray equipment.	
D. Paint Mixing, Matching, and Applying			
	1.	Identify the color code by the manufacturer's vehicle information label.	
	2.	Shake, stir, reduce, catalyze/activate, and strain refinish materials.	
	3.	Apply finish using the appropriate spray techniques for the finish being applied (e.g., gun arc, angle, distance, travel speed, spray pattern overlap).	
	4.	Apply a selected product on a test or let-down panel. Check for a color match, properly store and maintain a color catalog.	
	5.	Understand the application of single-stage topcoats.	
	6.	Apply a basecoat/clearcoat for panel blending, panel refinishing, and cut-ins.	
	7.	Apply a basecoat/clearcoat for overall refinishing.	
	8.	Remove nibs or imperfections from a basecoat.	
	9.	Identify product expiration dates as applicable.	
	10.	Refinish plastic parts.	
	11.	Apply multi-stage coats for panel blending and overall refinishing.	
	12.	Identify and mix paint using a formula.	
	13.	Identify poor hiding colors. Determine the necessary action.	
	14.	Tint color using a formula to achieve a blendable match.	
	15.	Identify an alternative color formula to achieve a blendable match.	
	16.	Identify the materials, equipment, and preparation differences between solvent and waterborne technologies.	
E. Paint Defects—Causes and Cures			

	1.	Identify blistering (i.e., raising of the paint surface, air entrapment). Correct the cause(s) and the condition.	
	2.	Identify a dry spray appearance in the paint surface. Correct the cause(s) and the condition.	
	3.	Identify the presence of fish-eyes (i.e., crater-like openings) in the finish. Correct the cause(s) and the condition.	
	4.	Identify lifting. Correct the cause(s) and the condition.	
	5.	Identify clouding (i.e., mottling and streaking in metallic finishes). Correct the cause(s) and the condition.	
	6.	Identify orange peel. Correct the cause(s) and the condition.	
	7.	Identify overspray. Correct the cause(s) and the condition.	
	8.	Identify solvent popping in a freshly painted surface. Correct the cause(s) and the condition.	
	9.	Identify sags and runs in a paint surface. Correct the cause(s) and the condition.	
	10.	Identify sanding marks or sand scratch swelling. Correct the cause(s) and the condition.	
	11.	Identify contour mapping/edge mapping. Correct the cause(s) and the condition.	
	12.	Identify color difference (off-shade). Correct the cause(s) and the condition.	
	13.	Identify tape tracking. Correct the cause(s) and the condition.	
	14.	Identify low-gloss condition. Correct the cause(s) and the condition.	
	15.	Identify poor adhesion. Correct the cause(s) and the condition.	
	16.	Identify paint cracking (e.g., shrinking, splitting, crowsfeet or line-checking, micro-checking, etc.). Correct the cause(s) and the condition.	
	17.	Identify corrosion. Correct the cause(s) and the condition.	
	18.	Identify dirt or dust in the paint surface. Correct the cause(s) and the condition.	
	19.	Identify water spotting. Correct the cause(s) and the condition.	
	20.	Identify finish damage caused by bird droppings, tree sap, and other natural causes. Correct the condition.	
	21.	Identify finish damage caused by airborne contaminants (e.g., acids, soot, rail dust, and other industrial-related causes). Correct the condition.	

	22.	Identify die-back conditions (i.e., dulling of the paint film showing haziness). Correct the cause(s) and the condition.	
	23.	Identify chalking (i.e., oxidation). Correct the cause(s) and the condition.	
	24.	Identify bleed-through (i.e., staining). Correct the cause(s) and the condition.	
	25.	Identify pinholing. Correct the cause(s) and the condition.	
	26.	Identify buffing-related imperfections (e.g., swirl marks, wheel burns). Correct the condition.	
	27.	Identify pigment flotation (i.e., color change through film build). Correct the cause(s) and the condition.	
F. Final Detail			
	1.	Apply decals, transfers, tapes, stone guards, moldings, and emblems, and so forth.	
	2.	Sand, buff, and polish fresh finish to remove defects and texture as required.	
	3.	Sand, buff, and polish existing finish to recondition defects as required and match the existing finish.	
	4.	Clean the interior, exterior, and glass.	
	5.	Clean body openings (e.g., door jambs, gaps, edges, etc.).	
	6.	Remove overspray.	
	7.	Perform vehicle clean-up. Complete quality control using a checklist.	
	8.	Measure and record film thickness before and after buffing.	
	9.	Perform nib sanding to remove small imperfections as required.	

Basic Non-Structural Analysis and Damage			
C. Outer Body Panel Repairs, Replacements, and Adjustments			
	1.	Inspect, analyze, perform, and evaluate procedures and skills pertaining to outer body panel repairs, replacements, and adjustments. DOK2	

Appendix A: Industry Standards

Collision Repair and Refinish Program Standards
Painting and Refinishing

	Units	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
PS		X										X										
WH			X																			
SP				X			X															
DA						X		X														
E									X													
VCP										X												
CRS											X											
SaP															X	X						
SuP					X								X				X					
SGE												X		X		X		X				
PMMA																			X			
PD-CC																				X		
FD																					X	
BNS																						X

Workplace Employability Skills
PS – Personal Standards
WH – Work Habits

Damage Analysis, Estimating, and Customer Service
SP – Safety Precautions
DA – Damage Analysis
E – Estimating
VCP – Vehicle Construction and Parts Identification
CRS – Customer Relations and Sales Skills

Paining and Refinishing
SaP – Safety Precautions
SuP – Surface Preparation
SGE – Spray Gun and Related Equipment Operation
PMMA – Paint Mixing, Matching, and Applying
PD-CC – Paint Defects – Causes and Cures
FD – Final Detail

Non-Structural
BNS – Basic Non-Structural

2015 Collision Repair Technician

Mississippi Department of Education

Program CIP: 47.0603 - Autobody/Collision and Repair Technology/Technician

Direct inquiries to

Instructional Design Specialist
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
601.359.3461

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, MS, as part of Mississippi State University, was established to foster educational enhancements and innovations. In keeping with the land grant mission of Mississippi State University, 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

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~~Scott Kolle, Project Manager for the Research and Curriculum Unit at Mississippi State University~~

~~Jolanda Young, Educational Technologist for the Research and Curriculum Unit at Mississippi State University~~

Standards

Standards are superscripted in each unit and are referenced in the appendices. Standards in the *Collision Repair Technician Curriculum Framework and Supporting Materials* are based on the following:

Industry Standards

NATEF was founded in 1983 as an independent, non-profit organization with a single mission: To evaluate technician training programs against standards developed by the automotive industry and recommend qualifying programs for certification (accreditation) by ASE, the National Institute for Automotive Service Excellence. For more information, visit http://www.natef.org/. Reprinted with permission.

I-CAR was formed in 1979 as a not-for-profit collision training organization. Its focus is on activities and resources that assist the collision repair industry achieve a high level of training for its technicians, and content is based on National Automotive Technicians Education Foundation (NATEF) standards. I-CAR technical training programs are developed and delivered to technicians in the collision industry. For more information, visit http://www.i-car.com/.

Common Core State Standards Initiative

The Common Core State Standards provide a consistent, clear understanding of what students are expected to learn, so teachers and parents know what they need to do to help them. The standards are designed to be robust and relevant to the real world, reflecting the knowledge and skills that our young people need for success in college and careers. With American students fully prepared for the future, our communities will be best positioned to compete successfully in the global economy. Copyright 2010. National Governors Association Center for Best Practices and Council of Chief State School Officers. All rights reserved. States and territories of the United States as well as the District of Columbia that have adopted the Common Core State Standards in whole are exempt from this provision, and no attribution to the National Governors Association Center for Best Practices and Council of Chief State School Officers is required. Reprinted from http://www.corestandards.org/.

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21st Century Skills and Information and Communication Technologies Literacy Standards

In defining 21st century learning, the Partnership for 21st Century Skills has embraced five content and skill areas that represent the essential knowledge for the 21st century: global awareness; civic engagement; financial, economic, and business literacy; learning skills that encompass problem-solving, critical-thinking, and self-directional skills; and information and communication technology (ICT) literacy.

Preface

Secondary career and technical education 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 true 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.

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 No Child Left Behind Act of 2001).

Mississippi Teacher Professional Resources

The following are resources for Mississippi teachers.

Curriculum, Assessment, Professional Learning, and other program resources can be found at The Research and Curriculum Unit's website: http://www.rcu.msstate.edu

Learning Management System: An online resourceLearning Management System information can be found at the RCU's website, under Professional Learning.

Should you need additional instructions, please call 662.325.2510.

My PLC: An online registration for all professional development sessions

To register for any session, teachers will need an account in the registration system, MyPLC, https://myplc.rcu.msstate.edu. To create an account, click on the link and navigate to the "Request a Guest ID" link. The ID should be the teacher's first initial and last name and the last four (4) digits of the social security number. Teachers should complete the entire form, which will then be sent to a secure server. Upon activation of the teacher's account, he or she will receive an e-mail with login instructions. The teacher may then browse for the available sessions and register for the desired courses.

Should you need additional instructions, please call 662.325.2510.

1.

Executive Summary

Pathway Description

Collision Repair is a pathway for students in the Transportation career cluster. The following description is from the current Standard Course of Study for Career Technical Education, Mississippi Department of Education. Collision Repair is a hands-on program that will prepare students for employment or continuing education in the collision repair industry. The content is based on industry content. The content consists of fundamentals, mechanical/electrical components, nonstructural analysis and damage repair, structural analysis and damage repair, and painting and refinishing.

The program is aligned with the NATEF 2012 Collision Repair and Refinishing standards, which were retrieved November 12, 2013, from http://www.natef.org.

Industry Certification

The Collision Repair pathway was written to incorporate the **National Automotive Technicians Education Foundation (NATEF)** and the **Inter-Industry Conference on Auto Collision Repair (I-CAR)** learning objectives, content, and hours. Any student who successfully completes this program will be eligible to apply to obtain the ASE exams. ASE requires two years of employment before certificates are issued. Students receive one year of credit for completion of the secondary program. Students who take certifications before the two-year requirement is met will be granted certifications after they complete one year of collision repair employment. NATEF and I-CAR are national certifications recognized throughout the automotive service industry. Each district should implement a maximum student number due to the size of each lab. Programs seeking certification (NATEF) may receive certification in Painting and Refinishing. Programs can seek certification in other areas if they so desire.

Assessment

The latest assessment blueprint for the curriculum can be found at the following location: http://www.rcu.msstate.edu/Curriculum/CurriculumDownload.aspx

Student Prerequisites

In order for students to be able 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 Math (last course taken or the instructor can specify the math)
3. Instructor Approval and TABE Reading Score (eighth grade or higher)

or

1. TABE Reading Score (eighth grade or higher)
2. Instructor Approval

or

1. Instructor Approval

Teacher Licensure

The latest teacher licensure information can be found at:
http://www.mde.k12.ms.us/educator-licensure

Professional Learning

If you have specific questions about the content of any of training sessions provided, please contact the Research and Curriculum Unit at 662.325.2510.

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Course Outlines

Option 1 – Four One-Carnegie-Unit Courses

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

1. **Fundamentals of Collision Repair – Course Code: 997102**
2. **Intermediate Painting and Refinishing – Course Code: 997103**
3. **Advanced Fundamentals of Collision Repair – Course Code: 997104**
4. **Advanced Painting and Refinishing – Course Code: 997105**

Course Description: Fundamentals of Collision Repair (Course Code: 997102)

Fundamentals of Collision Repair contains information on safety, tool identification/use, employee information, collision estimating, paint mixing/matching, service specification and service information, measurement, personal/ business finance, introduction to steering and suspension systems, concepts of electronic/electrical systems, concepts of brake systems, introduction to heating/cooling systems, concepts of cooling systems, introduction to restraint systems, inspecting and analyzing body components, repairs to outer body panels, information on frame inspection and repair, unibody inspection and repair, and introductory welding/cutting applications.

Course Description: Intermediate Painting and Refinishing (Course Code: 997103)

The Intermediate Painting and Refinishing course contains information and skills relating to painting and refinishing operations and surface preparations.

Course Description: Advanced Fundamentals of Collision Repair (Course Code: 997104)

Advanced Fundamentals of Collision Repair contains information on safety, tool identification/use, employee information, collision estimating, paint mixing/matching, service specification and service information, measurement, personal and business skills, metal finishing and body filling, movable glass/hardware, advanced welding, unibody measurement and repair, fixed glass procedures, and advanced welding/cutting applications.

Course Description: Advanced Painting and Refinishing (Course Code: 997105)

The Advanced Painting and Refinishing course contains information and skills relating to mixing and matching paint; paint defects, causes, and cures; and final detail practices.

Fundamentals of Collision Repair – Course Code: 997102

Unit	Unit Name	Hours
1	Introduction, Safety, and Student Organization	10
2	Fundamentals of Collision Repair	55
3	Basic Mechanical and Electrical Components	25
4	Basic Non-Structural Analysis and Damage Repair	25
5	Basic Structural Analysis and Damage Repair	25
Total		140

Intermediate Painting and Refinishing - Course Code: 997103

Unit	Unit Name	Hours
6	Introduction to Painting and Refinishing	60
7	Intermediate Painting and Refinishing	80
Total		140

Advanced Fundamentals of Collision Repair - Course Code: 997104

Unit	Unit Name	Hours
8	Safety (Review), Employability Skills, and Business Skills	10
9	Advanced Non-Structural Analysis and Damage Repair	65
10	Advanced Structural Analysis and Damage Repair	65
Total		140

Advanced Painting and Refinishing - Course Code: 997105

Unit	Unit Name	Hours
11	Introduction to Advanced Painting and Refinishing	60
12	Advanced Painting and Refinishing	80
Total		140

Option 2 – Two Two-Carnegie-Unit Courses

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

1. **Collision Repair Technician I – Course Code: 997100**
2. **Collision Repair Technician II – Course Code: 997101**

Course Description: Collision Repair Technician I (Course Code: 997100)

Collision Repair Technician I contains information on safety, tool identification/use, employee information, collision estimating, paint mixing/matching, service specification and service information, measurement, and personal/business finance, introduction to steering and suspension systems, concepts of electronic/electrical systems, concepts of brake systems, introduction to heating /cooling systems, concepts of cooling systems, introduction to restraint systems, inspecting and analyzing body components, repairs to outer body panels, frame inspection and repair, unibody inspection and repair, and introductory welding/cutting applications.

Course Description: Collision Repair Technician II (Course Code: 997101)

Collision Repair Technician II contains information on safety, tool identification/use, employee information, collision estimating, paint mixing/matching, service specification and service information, measurement, personal and business skills, metal finishing and body filling, movable glass/hardware, advanced welding, frame inspection and repair, unibody measurement and repair, fixed-glass procedures, and advanced welding/cutting applications.

Collision Repair Technician I – Course Code: 997100

Unit	Unit Name	Hours
1	Introduction, Safety, and Student Organization	10
2	Fundamentals of Collision Repair	55
3	Basic Mechanical and Electrical Components	25
4	Basic Non-Structural Analysis and Damage Repair	25
5	Basic Structural Analysis and Damage Repair	25
6	Introduction to Painting and Refinishing	60
7	Intermediate Painting and Refinishing	80
Total		280

Collision Repair Technician II – Course Code: 997101

Unit	Unit Name	Hours
8	Safety (Review), Employability Skills, and Business Skills	10
9	Advanced Non-Structural Analysis and Damage Repair	65
10	Advanced Structural Analysis and Damage Repair	65
11	Introduction to Advanced Painting and Refinishing	60
12	Advanced Painting and Refinishing	80
Total		280

- ~~Scheduling and operating more than one course in the same classroom/laboratory with the same teacher is not allowed.~~
- ~~Students must complete the first year with a score of 80/C or higher in class work to advance to the next level.~~

Research Synopsis

Introduction

Information listed at the end of each course was considered during the revision process. The National Automotive Technicians Education Foundation (NATEF) content was especially useful in providing insight into trends and issues in the field. The references in Appendix A are suggested for use by instructors and students during the study of the topics outlined. Advisory team members throughout the state worked to revise the curriculum framework. Educators and Industry indicate that the soft skills needed in this program include the following traits: maintaining a positive attitude, being at work everyday and on time, and having reading and writing skills related to the collision repair field.

Needs of the Future Workforce

Data for this synopsis were compiled from the Mississippi Department of Employment Security (2013). Employment opportunities for each of the occupations listed below are:

Table 1.1: Current and Projected Occupation Report

Description	**Jobs, 2010**	**Projected Jobs, 2020**	**Change (Number)**	**Change (Percent)**	**Average Hourly Earning**
Automotive Body and Related Repairers	1,060	1,070	10	0.9	$16.32
Automotive Service Technicians and Mechanics	4,280	4,450	170	4.0	$14.77
Automotive Glass Installers and Repairers	250	260	10	4.0	$13.92

Source: Mississippi Department of Employment Security; www.mdes.ms.gov (accessed September 12, 2013).

Perkins IV Requirements

The Collision Repair curriculum meets Perkins IV requirements of high-skill, high-wage, and/or high-demand occupations by introducing students to and preparing students for occupations. Additionally, the Collision Repair curriculum is integrated with academic common core standards. Lastly, the curriculum focuses on ongoing and meaningful professional development for teachers as well as relationships with industry.

Curriculum Content

Results from the survey indicate that there are four employment areas in the Mississippi collision industry: Glass installer and repairer, body repairer, painter/refinisher, and auto appraiser. Most of the respondents from the survey indicated that they had never viewed a secondary curriculum but would be willing to when the curriculum is finished. They also indicated that they did not know what was taught in the secondary programs. They did emphasize that students need hands-on experience with the basic tasks that are required to be a technician. "Hands-on" does not mean perform the task one time. Repetition is the key to perfect the skill level and knowledge.

Specific job skills requested are problem solving, cooperative learning, and organization. Specific academic skills identified are math, reading/writing, and basic computer skills. Specific collision repair topics mentioned are as follows:

- **Air Bags** – Students need to know how to safely disarm an air bag. They also need to know how to work around an air bag.
- **Adhesives, Bonding, and Fillers** – Students need working knowledge of adhesives, bonding, and fillers. They should be able to actually use adhesives, bonding, and fillers to repair certain damage. Knowledge of the different types of plastics and how to repair each was emphasized.
- **Frames** – Students need to how to identify basic frame damage and then discuss repair techniques or procedures. The actual repair may need to be left to the community college.
- **Glass** (stationary/moveable) – These tasks are not performed in most of the shops, and most shops subcontract this work to an independent mobile glass service. Although most shops do not perform these tasks, it is an area for which secondary career programs could introduce skill and knowledge.
- **Mechanical and Electrical** – Less hands-on time for these tasks is needed. Students need to be able to identify parts of the vehicle related to mechanical and electrical content. Larger repair shops have separate technicians who perform these tasks. In smaller shops, technicians may perform all aspects of the repair.
- **Paint and Refinishing** – Students need to focus on the skills of preparation of a vehicle to prime and paint. These tasks must be done on different areas of a vehicle.
- **Welding** – MIG welding is required, and plasma should be introduced. Students should learn how to identify the types of metals and apply basic repair procedures. Students also need to explore working with alloys, aluminum, and magnesium.
- **Estimating** – Students need to be able to inspect damage, evaluate the most cost-efficient repair, and estimate a total cost. Written communication is a must for this task to be completed.
- **General Knowledge** – The student must be able to read and understand technical manuals, diagrams, and schematics. A good understanding of the collision industry and mechanical ability is a must for the student to be successful.

Certifications and training were not indicated as being requirements for acquiring a job. Training and certification may be encouraged or required depending on the particular business environment. All respondents indicated that new employees serve as an apprentice to a senior technician. During this time, the senior technician assigns simple tasks that need to be completed. As skill level, experience, and knowledge increase, more complex tasks are assigned.

Collision repair skills and knowledge take time to perfect. The NATEF standards provide the tasks, which, if taught, should provide employers with an employee that has skills and knowledge that will enable him or her to be successful. The tasks need to be performed over and over again in order for them to be mastered and understood. For technicians to be successful, they must continue training throughout their careers. For students to be successful in the workplace, emphasis needs to be placed on a hands-on understanding of the material.

Industry Standards

The National Automotive Technicians Education Foundation (NATEF) creates the industry standards found in this curriculum. "NATEF was founded in 1983 as an independent, non-profit organization with a single mission: to evaluate technician training programs against standards developed by the automotive industry and recommend qualifying programs for certification (accreditation) by ASE, the National Institute for Automotive Service Excellence. For more information, visit http://www.natef.org/."

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National Educational Technology Standards for Students

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Transition to Postsecondary Education

The latest articulation information for Secondary to Postsecondary can be found at the Mississippi Community College Board (MCCB) website http://www.mccb.edu/

Best Practices

Innovative Instructional Technologies

Recognizing that today's students are digital learners, the classroom should be equipped with tools that will teach them in the way they need to learn. The Collision Repair instructor's goal should be to include teaching strategies that incorporate current technology. To make use of the latest online communication tools and introduce students to education in an online environment, the classroom teacher is encouraged to use a learning management system. An online learning management system allows students to work collaboratively and also enables the teacher to connect more effectively with students by keeping them informed and involved.

Differentiated Instruction

Students learn in a variety of ways. Some are visual learners, needing only to read information and study it to succeed. Others are auditory learners, thriving best when information is read aloud to them. Still others are tactile learners, needing to participate actively in their learning

experiences. Add the student's background, emotional health, and circumstances, and a very unique learner emerges. Many activities are graded by rubrics that allow students to choose the type of product they will produce. By providing various teaching and assessment strategies, students with various learning styles can succeed.

Career and Technical Education Student Organizations

Teachers should investigate opportunities to sponsor a student organization. In Mississippi, Skills USA foster the types of learning expected from the Collision Repair curriculum. Skills USA prepares emerging leaders and entrepreneurs for careers in the automotive collision repair industries. The mission of Skills USA is to help its members become world-class workers, leaders, and responsible American citizens.

Cooperative Learning

Cooperative learning can help students understand topics when independent learning cannot. Therefore, you will see several opportunities in the Collision Repair 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. Collision Repair curriculum provides opportunities for students to work together and help each other to complete complex tasks.

Conclusions

Collision Repair is a driving force in the Mississippi's economic development. A workforce trained to work in this industry will sustain existing collision and repair businesses. Students who complete this program are well equipped to enter the workforce or to pursue educational opportunities at community colleges and universities in Mississippi.

Professional Organizations

Association for Supervision and Curriculum Development (ASCD)
1703 North Beauregard Street
Alexandria, VA 22311-1714
(800) 933-ASCD
http://www.ascd.org

Association for Career and Technical Education (ACTE)
1410 King Street
Alexandria, VA 22314
(800) 826-9972
http://www.acteonline.org

Mississippi Association for Supervision and Curriculum Development (MASCD)
P.O. Box 13576
Jackson, MS 39236
(601) 591-2210
http://www.mascd.com

Mississippi Department of Education (MDE)
Office of Vocational Education and Workforce Development
P.O. Box 771
Jackson, MS 39205
(601) 359-3940
http://www.mde.k12.ms.us/vocational/news/

SkillsUSA
14001 SkillsUSA Way
Leesburg, VA 20176
703-777-8810
FAX: 703-777-8999
http://www.skillsusa.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.

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 (SATP) 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. 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.

Unit 1: Introduction, Safety, and Student Organization

Competencies and Suggested Objectives
1. Describe local program and center expectations, policies, and procedures. DOK 1, EMP a. Describe local program and career center policies and procedures, including dress code, attendance, academic requirements, discipline, shop/lab rules and regulations, and transportation regulations. b. Give a brief overview of the course. Explain to students what Autobody/Collision and Repair Technology/Technician is, why it is important, and how it will be delivered. c. Compare and contrast local program and school policies to expectations of employers. d. Preview course objectives, program policy, and the industry standards.
2. Describe employment opportunities and responsibilities. DOK 1, EMP a. Describe employment opportunities, including potential earnings, employee benefits, job availability, working conditions, educational requirements, required technology skills, and continuing education/training. b. Describe basic employee responsibilities and appropriate work ethics. c. Compare and contrast employment responsibilities and expectations to local school and program policies and expectations. d. Demonstrate computer systems and their uses in the automotive collision industry. e. Define effective relationship skills and workplace issues, including but not limited to sexual harassment, stress, and substance abuse.
3. Research, design, and conduct a project that will apply the knowledge and skills learned in the Collision Pathway course in a real-world, unpredictable environment. DOK3, EMP a. Demonstrate effective team-building and leadership skills. b. Explore leadership skills and personal-development opportunities provided to students through student organizations such as SkillsUSA. c. Work as a team to design a community service project for which the knowledge and skills learned in the course can be used to improve the lives of others.

Unit 2: Fundamentals of Collision Repair

Competencies and Suggested Objectives
1. Introduce, describe, and distinguish local program and vocational/career technical center policies and procedures. DOK 2, CRN1, CRS2, CRS3, CRP4 a. Describe local program and vocational/career technical center policies and procedures including dress code, attendance, academic requirements, discipline, and the school's acceptable use of technology policy and transportation regulations. b. Compare and contrast local program policies, procedures, and expectations with industry policies, procedures, and expectations.
2. Introduce, describe, and express employment opportunities and responsibilities of the collision repair industry. DOK 2, CRN1, CRS2, CRS3, CRP4 a. Introduce concepts associated with the collision repair industry; describe employment opportunities including potential earnings, employee benefits, job availability, place of employment, working conditions, and educational requirements. b. Describe basic employee responsibilities and how to communicate effectively in on-the-job situations. Identify and apply the practices that affect employer and employee decision making as it relates to identifying and applying appropriate algebraic formulas to personal finance situations, linear programming to business decisions, and algebraic formulas to personal and business investments. c. Discuss the history of the collision repair industry including materials, terminology, and techniques. d. Research and report the computerized systems used for estimating collision repairs, measuring damage, and mixing or matching paint.
3. Investigate and replicate leadership skills and personal development. DOK 2, CRN1, CRS2, CRS3, CRP4 a. Demonstrate effective team-building and leadership skills. b. Model appropriate work ethics.
4. Model general safety rules for working in a shop/lab and an industry setting. DOK 2, CRN1, CRS2, CRS3, CRP4 a. Explain the importance of following all safety rules, policies and liability issues (reporting all on-the-job injuries and accidents), evacuation policy, substance abuse policy, and procedures when working near pressurized or high temperature, and explain electrical hazards and the action to take when an electrical shock occurs when performing collision operations (personal protective equipment, procedures for lifting heavy objects, and MSDS sheets). b. Explain the process by which fires start, fire prevention of various flammable liquids, the classes of fire and the types of extinguishers. c. Identify and demonstrate the safe and proper use of common hand tools.

5. Interpret and apply service specifications and information. DOK 2, CRN1, CRS2, CRS3, CRP4
   a. Locate and interpret service specifications and information, using both print and computerized service information references and vehicle and major component identification numbers (VIN, certification, and calibration labels).
   b. Interpret and apply information to a specific job on a specific vehicle.

6. Demonstrate measurement practices used in the automotive service. DOK 2, CRN1, CRS2, CRS3, CRP4
   a. Measure the length of an object using a rule to the nearest 1/16 in. and 1 mm.
   b. Identify the different types of bolts (grade, diameter, length, and thread pitch), nuts, and washers, and describe their appropriate uses.
   c. Identify different glues and sealants used in automotive service, and describe their appropriate uses.

Unit 3: Basic Mechanical and Electrical Components

Competencies and Suggested Objectives
1. Identify, evaluate, and practice suspension and steering components and systems. DOK 2, CRN1, CRS2, CRS3, CRP4 a. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, and causes and corrections; measure vehicle ride height and check for front wheel setback; determine needed repairs. b. Identify and inspect (where applicable) steering linkage geometry (attitude/parallelism), Pitman arm, relay (center link/intermediate) rod, idler arm and mountings, tie rod sleeves, clamps, tie rod ends, steering linkage damper, shock absorbers, upper/lower control arms, upper/lower control arm bushings, shafts and rebound bumpers, and upper and lower ball joints. c. Analyze and diagnose wheel and tire repairs according to according to manufacturer's specifications.
2. Practice concepts and procedures related to electrical/electronic systems. DOK 2, CRN1, CRS2, CRS3, CRP4 a. Inspect and repair basic electrical wiring. b. Diagnose and perform procedures related to the battery.
3. Diagnose and apply practices related to brakes and braking systems. DOK 2, CRN1, CRS2, CRS3, CRP4 a. Identify and discuss various brake components and the replacement/repair procedures.
4. Discuss and apply practices related to heating and air conditioning. DOK 2, CRN1, CRS2, CRS3, CRP4 a. Identify and comply with environmental concerns relating to refrigerants and coolants. b. Locate and identify A/C system service ports; discuss the procedure of evacuation of the A/C system including checking for leaks and recharging the A/C system with refrigerant; and perform a leak test.
5. Identify and discuss cooling systems. DOK 2, CRN1, CRS2, CRS3, CRP4 a. Identify and inspect engine cooling and heater system hoses, belts, radiator, pressure cap, coolant recovery system, and water pump. b. Discuss the procedure to recover, refill, and bleed a system with proper coolant and check the level of protection; leak test system and dispose of materials in accordance with EPA specifications.
6. Diagnose and replace active restraint systems procedures and practices. DOK 2, CRN1, CRS2, CRS3, CRP4 a. Analyze and replace (if needed) components related to seat belts.

Unit 4: Basic Non-Structural Analysis and Damage Repair

Competencies and Suggested Objectives
1. Inspect, analyze, perform, and evaluate procedures and skills pertaining to non-structural analysis and damage repair. DOK 3, CRN1, CRS2, CRS3, CRP4 a. Identify, inspect, determine necessary action, and perform that procedure when preparing body components. b. Inspect, analyze, and perform repairs as they relate to outer body panels: repairs, replacement, and adjustments. c. Determine and perform skills and evaluate procedures as they relate to metal finishing and body filling. d. Identify and determine correct procedure and perform the skill as it relates to metal welding and cutting procedures for non-structural applications. e. Remove and install (R&I) or remove and replace (R&R) trim, damaged and undamaged components.

Unit 5: Basic Structural Analysis and Damage Repair

Competencies and Suggested Objectives
1. Inspect, apply, and perform skills and techniques related to vehicles pertaining to structural and damage repair. DOK 2, CRN1, CRS2, CRS3, CRP4 a. Identify the basic frame construction types and their applications. b. Identify and inspect, determine necessary action, and perform that procedure when performing frame inspection and repair. c. Identify, diagnose, recommend, and/or perform the necessary repair action in unibody inspection, measurement, and repair.
2. Identify and analyze the proper metal welding procedures to complete a repair according to manufacturer's specifications. DOK 2, CRN1, CRS2, CRS3, CRP4 a. Identify and discuss various metal properties. b. Identify, practice, and evaluate metal welding and cutting procedures for structural applications – unibody and non-unibody, ladder frame

Unit 6: Introduction to Painting and Refinishing

Competencies and Suggested Objectives
1. Explain procedures as they pertain to introductory painting and refinishing. DOK 2, CRN1, CRS2, CRS3, CRP4 a. Describe safety precautions for painting and refinishing operations. b. Discuss surface preparation methods.

Unit 7: Intermediate Painting and Refinishing

Competencies and Suggested Objectives
1. Evaluate and perform procedures as they pertain to intermediate painting and refinishing. DOK 2, CRN1, CRS2, CRS3, CRP4 a. Practice safety precautions for painting and refinishing operations. b. Demonstrate and evaluate surface preparation information and skills.

Unit 8: Safety (Review), Employability Skills, and Business Skills

Competencies and Suggested Objectives
1. Introduce and understand general safety rules for working in a shop/lab and industry. DOK 2, CRN1, CRS2, CRS3, CRP4 a. Explain the importance of following all safety rules and policies
2. Demonstrate proper use and care for laboratory equipment related to the collision industry. DOK 2, CRN1, CRS2, CRS3, CRP4 a. Describe basic employee responsibilities. b. Design a resume and letter of application and complete a job application. c. Demonstrate an understanding of the impact of consumer credit (advantages and disadvantages of installment loans, applying algebraic formulas to consumer credit). d. Design, collect, and apply information for planning a trip to local industry.

Unit 9: Advanced Non-Structural Analysis and Damage Repair

Competencies and Suggested Objectives
1. Inspect, analyze, perform, and evaluate procedures and skills pertaining to advanced non-structural analysis and damage repair. DOK 2, CRN1, CRS2, CRS3, CRP4 a. Identify and utilize metal finishing and body filling procedures. b. Inspect and diagnose moveable glass and hardware. c. Identify, analyze, and perform operations pertaining to welding. d. Recognize and apply plastics and adhesives.

Unit 10: Advanced Structural Analysis and Damage Repair

Competencies and Suggested Objectives
1. Inspect, analyze, and identify skills, and evaluate vehicles pertaining to advanced structural analysis and damage repair. DOK 2, CRN1, CRS2, CRS3, CRP4 a. Identify, analyze, and perform frame inspection and repair. b. Analyze and determine necessary action to repair unibody including inspection, measurement, and repair. c. Identify procedures for fixed glass. d. Identify and perform metal welding and cutting principles and practices.

Unit 11: Introduction to Advanced Painting and Refinishing

Competencies and Suggested Objectives
1. Introduce and discuss procedures as they pertain to introductory skills of advanced painting and refinishing. DOK 2, CRN1, CRS2, CRS3, CRP4 a. Identify and discuss paint-related skills and techniques as they pertain to mixing, matching, and applying. b. Identify and discuss the most common paint defect causes and cures. c. Identify and discuss final detail practices.

Unit 12: Advanced Painting and Refinishing

Competencies and Suggested Objectives
1. Evaluate and perform procedures as they pertain to advanced painting and refinishing. DOK 2, CRN1, CRS2, CRS3, CRP4 a. Identify and perform paint-related skills and techniques as they pertain to mixing, matching, and applying. b. Identify and analyze the most common paint defect causes and cures. c. Explain and perform final detail practices.

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, place the date on which the student mastered the competency.

Unit 1: Introduction, Safety, and Student Organization		
	1.	Describe local program and center expectations, policies, and procedures.
	2.	Describe employment opportunities and responsibilities.
	3.	Research, design, and conduct a project that will apply the knowledge and skills learned in the Collision Pathway course in a real-world, unpredictable environment.
Unit 2: Fundamentals of Collision Repair		
	1.	Introduce, describe, and distinguish local program and vocational/career technical center policies and procedures.
	2.	Introduce, describe, and express employment opportunities and responsibilities of the collision repair industry.
	3.	Investigate and replicate leadership skills and personal development.
	4.	Model general safety rules for working in a shop/lab and an industry setting.
	5.	Interpret and apply service specifications and information.
	6.	Demonstrate measurement practices used in the automotive service.
Unit 3: Basic Mechanical and Electrical Components		
	1.	Identify, evaluate, and practice suspension and steering components and systems.
	2.	Practice concepts and procedures related to electrical/electronic systems.
	3.	Diagnose and apply practices related to brakes and braking systems.
	4.	Discuss and apply practices related to heating and air conditioning.
	5.	Identify and discuss cooling systems.
	6.	Diagnose and replace active restraint systems procedures and practices.
Unit 4: Basic Non-Structural Analysis and Damage Repair		
	1.	Inspect, analyze, perform, and evaluate procedures and skills pertaining to non-structural analysis and damage repair.

~~Unit 5: Basic Structural Analysis and Damage Repair~~		
	~~1.~~	~~Inspect, apply, and perform skills and techniques related to vehicles pertaining to structural and damage repair.~~
	~~2.~~	~~Identify and analyze the proper metal welding procedures to complete a repair according to manufacturer's specifications.~~
~~Unit 6: Introduction to Painting and Refinishing~~		
	~~1.~~	~~Explain procedures as they pertain to introductory painting and refinishing.~~
~~Unit 7: Intermediate Painting and Refinishing~~		
	~~1.~~	~~Evaluate and perform procedures as they pertain to intermediate painting and refinishing.~~
~~Unit 8: Safety (Review), Employability Skills, and Business Skills~~		
	~~1.~~	~~Introduce and understand general safety rules for working in a shop/lab and industry.~~
	~~2.~~	~~Demonstrate proper use and care for laboratory equipment related to the collision industry.~~
~~Unit 9: Advanced Non-Structural Analysis and Damage Repair~~		
	~~1.~~	~~Inspect, analyze, perform, and evaluate procedures and skills pertaining to advanced non-structural analysis and damage repair.~~
~~Unit 10: Advanced Structural Analysis and Damage Repair~~		
	~~1.~~	~~Inspect, analyze, and identify skills, and evaluate vehicles pertaining to advanced structural analysis and damage repair.~~
~~Unit 11: Introduction to Advanced Painting and Refinishing~~		
	~~1.~~	~~Introduce and discuss procedures as they pertain to introductory skills of advanced painting and refinishing.~~
~~Unit 12: Advanced Painting and Refinishing~~		
	~~1.~~	~~Evaluate and perform procedures as they pertain to advanced painting and refinishing.~~

Appendix A: Unit References

All of the Collision Repair Technician units use the same resources for each unit. You will find suggested resources listed below.

Journals

Automotive Service Association. (n.d.). *AutoInc.* Retrieved November 12, 2013, from http://www.autoinc.org/

Babcox. (n.d.). *BodyShop Business.* Retrieved November 12, 2013, from http://www.bodyshopbusiness.com/

Babcox. (n.d.). *Tomorrow's Technician*. Retrieved November 12, 2013, from http://www.tomorrowstechnician.com/

National Institute for Automotive Service Excellence. (n.d.). *ASE Blue Seal News Tech News.* Retrieved November 12, 2013, from http://www.ase.com

Texts

Duffy, J. (2001). *I-CAR professional automotive collision repair*. Albany, NY: Delmar Thompson Learning. ISBN 0-7668-1398-4. (Instructor's text, student workbook, and interactive DVD available)

Duffy, J. (2007). *Collision Repair Fundamentals.* Albany, NY: Delmar Cengage Learning. ISBN1-4180-1336-6. (Student workbook available).

Duffy, J. (2008). *Auto body repair technology, 5th edition*. Albany, NY: Delmar Cengage Learning. ISBN 1-4180-7353-9. (Instructor's text, student workbook, and interactive DVD available).

Duffy, J. (2014). *Auto body repair technology, 6th edition*. Albany, NY: Delmar Cengage Learning. ISBN 1-1337-0285-6. (Instructor's text, student workbook, and interactive DVD available).

Videos

Films Media Group. (2005). *Miscellaneous Repairs.* (Available in DVD from Films Media Group, P.O. Box 2053, Princeton, NJ 08543, 1-800-257-5126. ISBN 978-1-4213-1475-4, http://www.filmsmediagroup.com/)

Films Media Group. (2005). *Surface Preparation and Refinishing.* (Available in DVD from Films Media Group, P.O. Box 2053, Princeton, NJ 08543, 1-800-257-5126, ISBN 978-1-4213-1474-7, http://www.filmsmediagroup.com/)

Web Sites

How stuff works. (n.d.). Retrieved February 5, 2014, from http://auto.howstuffworks.com/

I-Car. (n.d.). Retrieved February 5, 2014, from http://www.i-car.com/

National Institute for Automotive Service Excellence. (n.d.). Retrieved February 5, 2014, from https://www.ase.com/tests/ase-certification-tests.aspx

Appendix B: Industry Standards

NATEF Standards

Crosswalk for Collision Repair Technician											
	Units	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8	Unit 9	Unit 10
CRN1-Non-Structural Analysis and Damage Repair		X	X	X	X	X	X	X	X	X	
CRS2-Structural Analysis and Damage Repair		X	X		X	X	X	X	X	X	
CRS3-Mechanical and Electrical Components		X	X	X	X	X	X	X	X	X	
CRP4-Painting and Refinishing		X		X	X	X	X	X	X	X	

Crosswalk for Collision Repair Technician											
	Units	Unit 11	Unit 12								
CRN1-Non-Structural Analysis and Damage Repair		X	X								
CRS2-Structural Analysis and Damage Repair		X	X								
CRS3-Mechanical and Electrical Components		X	X								
CRP4-Painting and Refinishing		X	X								

"NATEF Program Accreditation Standards." Natef.org, Accessed 8/13/14. http://www.natef.org/NATEF/media/NATEFMedia/Accreditation/Accreditation%20Docs/2013%20Accreditation%20Docs/2013%20Collision%20Docs/2013-Collision-Program-Standards.pdf

Appendix C: 21st Century Skills[1]

	Units	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8	Unit 9	Unit 10
21st Century Standards											
CS1		X					X	X			X
CS2		X					X	X			X
CS3											
CS4			X	X	X	X	X	X	X	X	
CS5											
CS6		X	X	X	X	X	X	X	X	X	X
CS7		X	X	X	X	X	X	X	X	X	X
CS8		X	X	X	X	X	X	X	X	X	X
CS9		X	X	X							X
CS10											
CS11			X	X							
CS12		X	X	X	X	X	X	X	X	X	X
CS13		X	X	X	X	X	X	X	X	X	X
CS14		X	X	X	X	X	X	X	X	X	X
CS15		X	X	X	X	X	X	X	X	X	X
CS16		X	X	X	X	X	X	X	X	X	X

	Units	Unit 11	Unit 12							
21st Century Standards										
CS1										
CS2										
CS3										
CS4		X	X							
CS5										
CS6		X	X							
CS7		X	X							
CS8		X	X							
CS9		X	X							
CS10										
CS11		X	X							
CS12		X	X							
CS13		X	X							
CS14		X	X							
CS15		X	X							
CS16		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

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

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. 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 D: Common Core Standards

	Units	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8	Unit 9	Unit 10
Common Core Standards											
RL.11.1.											
RL.11.2.		X									
RL.11.3.		X	X	X	X	X	X	X	X	X	X
RL.11.4.		X	X	X	X	X	X	X	X	X	X
RL.11.5.											
RL.11.6.											
RL.11.7.											
RL.11.8.											
RL.11.9.											
RL.11.10.											
RI.11.1.											
RI.11.2.											
RI.11.3.											
RI.11.4.											
RI.11.5.											
RI.11.6.											
RI.11.7.											
RI.11.8.											
RI.11.9.											
RI.11.10.											
W.11.1.											
W.11.2.											
W.11.3.											
W.11.4.											
W.11.5.											
W.11.6.		X	X	X	X	X	X	X	X	X	X
W.11.7.											
W.11.8.											
W.11.9.											
W.11.10.											
SL.11.1.											
SL.11.2.											
SL.11.3.											
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RH.11.7.											
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RH.11.9.											
RH.11.10.											
RST.11.1.											
RST.11.2.											
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~~RST.11.10.~~											
~~WHST.11.1.~~											
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~~WHST.11.10.~~											

	~~Units~~	~~Unit 11~~	~~Unit 12~~								
~~Common Core Standards~~											
~~RL.11.1.~~											
~~RL.11.2.~~											
~~RL.11.3.~~		~~X~~	~~X~~								
~~RL.11.4.~~		~~X~~	~~X~~								
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RST.11.9.											
RST.11.10.											
WHST.11.1.											
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Reading Standards for Literature (11-12)

College and Career Readiness Anchor Standards for *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 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.
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.

Reading Standards for Informational Text (11-12)

College and Career Readiness Anchor Standards for *Informational Text*

Key Ideas and Details

RI.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.

RI.11.2. Determine two or more 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 provide a complex analysis; provide an objective summary of the text.

RI.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

RI.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).

RI.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.

RI.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

RI.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.

RI.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).

RI.11.9. Analyze seventeenth , eighteenth , and nineteenth-century foundational U.S. documents of historical and literary significance (including The 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

RI.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.
By the end of grade 12, read and comprehend literary nonfiction at the high end of the grades 11–CCR text complexity band independently and proficiently.

College and Career Readiness Anchor Standards for *Writing*

Text Types and Purposes

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

a. Introduce precise, 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.

b. 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.

c. 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.

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.

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.

a. 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.

b. 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.

c. 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.

d. Use precise language, domain-specific vocabulary, and techniques such as metaphor, simile, and analogy 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).

W.11.3. 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 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.

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 and build toward a particular tone and outcome (e.g., a sense of mystery, suspense, growth, or resolution).

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

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.)

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 on page 54.)

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.

a. 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").

b. 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.

College and Career Readiness Anchor Standards for *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.

a. 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.

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

c. 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.

d. 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.

SL.11.5. 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 on page 54 for specific expectations.)

College and Career Readiness Anchor Standards for *Language*

Conventions of Standard English

L.11.1. Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.

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

b. 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.11.2. Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.

a. Observe hyphenation conventions.

b. Spell correctly.

Knowledge of Language

L.11.3. 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.

a. 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.

a. 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.

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

c. 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, its etymology, or its standard usage.

d. 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.11.5. Demonstrate understanding of figurative language, word relationships, and nuances in word meanings.

a. Interpret figures of speech (e.g., hyperbole, paradox) in context and analyze their role in the text.
b. Analyze nuances in the meaning of words with similar denotations.

L.11.6. 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.

Reading Standards for Literacy in History/Social Studies (11-12)

Key Ideas and Details

RH.11.1 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.11.2. 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.11.3. 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.11.4. 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.11.5. 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.11.6. 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.11.7. 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.11.8. Evaluate an author's premises, claims, and evidence by corroborating or challenging them with other information.

RH.11.9. 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.11.10. By the end of grade 12, read and comprehend history/social studies texts in the grades 11–CCR text complexity band independently and proficiently.

Reading Standards for Literacy in Science and Technical Subjects (11-12)

Key Ideas and Details

RST.11.1. 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.11.2. 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.11.3. 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.11.4. 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.11.5. Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.

RST.11.6. 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.

Integration of Knowledge and Ideas

RST.11.7. 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.11.8. 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.11.9. 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.11.10. By the end of grade 12, read and comprehend science/technical texts in the grades 11–CCR text complexity band independently and proficiently.

Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects (11-12)

Text Types and Purposes

WHST.11.1. Write arguments focused on discipline-specific content.

a. 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.

b. 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.

c. 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.

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 or supports the argument presented.

WHST.11.2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.

a. 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.

b. 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.

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

d. 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.

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

WHST.11.3. (Not applicable as a separate requirement)

Production and Distribution of Writing

WHST.11.4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

WHST.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.

WHST.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

WHST.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.

WHST.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 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.

WHST.11.9. Draw evidence from informational texts to support analysis, reflection, and research.

Range of Writing

WHST.11.10. 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.

~~**Common Core Crosswalk for Mathematics (11-12)**~~

	Units	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8	Unit 9	Unit 10
Common Core Standards											
N-RN.1.											
N-RN.2.											
N-RN.3.		X				X					X
N-Q.1.											
N-Q.2.											
N-Q.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.											
N-VM.1.											
N-VM.2.											
N-VM.3.				X	X				X	X	
N-VM.4.		X			X	X	X	X	X	X	X
N-VM.5.											
N-VM.6.											
N-VM.7.											
N-VM.8.											
N-VM.9.											
N-VM.10.											
N-VM.11.											
N-VM.12.											
A-SSE.1.			X			X					X
A-SSE.2.											
A-SSE.3.											
A-SSE.4.											
A-APR.1.											
A-APR.2.											
A-APR.3.											
A-APR.4.											
A-APR.5.											
A-APR.6.											
A-APR.7.					X					X	
A-CED.1.											
A-CED.2.											
A-CED.3.											
A-CED.4.											
A-REI.1.											
A-REI.2.											
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A-REI.9.											
A-REI.10.											
A-REI.11.											
A-REI.12.											
F-IF.1.											
F-IF.2.											
F-BF.3.											
F-BF.4.											
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Common Core Crosswalk for Mathematics (11-12)

	Units	Unit 11	Unit 12								
Common Core Standards											
N-RN.1.											
N-RN.2.											
N-RN.3.		X	X								
N-Q.1.											
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N-Q.3.											
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N-VM.1.											
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N-VM.3.											
N-VM.4.		X	X								
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N-VM.12.											
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~~Mathematics (High School)~~

~~Number and Quantity~~

~~The Real Number System~~

~~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.~~

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

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.

Quantities

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.

The Complex Number System

N-CN.1. Know there is a complex number i such that i2= −1, and every complex number has the form a + bi with a and b real.

N-CN.2. Use the relation i2= −1 and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.

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

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 + √3 i)3= 8 because (−1 + √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.

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

N-CN.8. (+) Extend polynomial identities to the complex numbers. For example, rewrite x2+ 4 as (x + 2i)(x − 2i).

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

Vector and Matrix 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.

N-VM.4. (+) Add and subtract vectors

N-VM.4.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.

N-VM.4.b. Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum.

N-VM.4.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.

N-VM.5.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).

N-VM.5.b. Compute the magnitude of a scalar multiple cv using ||cv|| = |c|v. Compute the direction of cv knowing that when |c|v ≠ 0, the direction of cv is either along v (for c > 0) or against v (for c < 0).

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

Seeing Structure in Expressions

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

A-SSE.1.a. Interpret parts of an expression, such as terms, factors, and coefficients.

A-SSE.1.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. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.

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-SSE.3.a. Factor a quadratic expression to reveal the zeros of the function it defines.

A-SSE.3.b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.

A-SSE.3.c. Use the properties of exponents to transform expressions for exponential functions.

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.

Arithmetic with Polynomials and Rational Expressions

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

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.

A-APR.4. Prove polynomial identities and use them to describe numerical relationships.

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.

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.

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.

Creating Equations

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 nonviable 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.

Reasoning with Equations and Inequalities

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.

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-REI.4.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.

A-REI.4.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 $a \pm bi$ for real numbers a and b.

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.

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 $x^2+y^2 = 3$.

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).

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

Interpreting Functions

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 $n \geq 1$.

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.

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.

F-IF.7.a. Graph linear and quadratic functions and show intercepts, maxima, and minima.

F-IF.7.b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.

F-IF.7.c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.

F-IF.7.d. (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.

F-IF.7.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.

F-IF.8.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.8.b. Use the properties of exponents to interpret expressions for exponential functions.

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.

Building Functions

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

F-BF.1.a. Determine an explicit expression, a recursive process, or steps for calculation from a context.

F-BF.1.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.1.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.

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.

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.

F-BF.4.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.

F-BF.4.b. (+) Verify by composition that one function is the inverse of another.

F-BF.4.c. (+) Read values of an inverse function from a graph or a table, given that the function has an inverse.

F-BF.4.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.

Linear, Quadratic, and Exponential Models

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

F-LE.1.a. Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.

F-LE.1.b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.

F-LE.1.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.

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

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

Trigonometric Functions

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.

F-TF.3. (+) Use special triangles to determine geometrically the values of sine, cosine, tangent for $\pi/3$, $\pi/4$ and $\pi/6$, and use the unit circle to express the values of sine, cosine, and tangent for $\pi - x$, $\pi+x$, and $2\pi - x$ 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.

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

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.

F-TF.8. Prove the Pythagorean identity sin2 (θ) + cos 2 (θ) = 1 and use it to find sin(θ), cos(θ), or tan(θ) given sin(θ), cos(θ), or tan(θ) and the quadrant of the angle.

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

~~Geometry~~

~~Congruence~~

~~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.~~

~~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.~~

~~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.

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.

Similarity, Right Triangles, and Trigonometry

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

G-SRT.1.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.

G-SRT.1.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.

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.

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.

G-SRT.9. (+) Derive the formula A = 1/2 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).

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.

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

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.

Expressing Geometric Properties with Equations

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.

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.

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.

Geometric Measurement and Dimension

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.2. (+) Give an informal argument using Cavalieri's principle for the formulas for the volume of a sphere and other solid figures.

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

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.

Modeling with Geometry

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

Interpreting Categorical and Quantitative Data

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).

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.

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.

S-ID.6.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.

S-ID.6.b. Informally assess the fit of a function by plotting and analyzing residuals.

S-ID.6.c. Fit a linear function for a scatter plot that suggests a linear association.

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.

Making Inferences and Justifying Conclusions

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?

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.

Conditional Probability and the Rules of Probability

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.

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.

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.

Using Probability to Make Decisions

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?

S-MD.5. (+) Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values.

S-MD.5.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.

S-MD.5.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).

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

	Course	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8	Unit 9	Unit 10
ISTE Standards											
T1		X	X	X	X	X	X	X	X	X	X
T2		X	X	X	X	X	X	X	X	X	X
T3		X	X	X	X	X	X	X	X	X	X
T4		X	X	X	X	X	X	X	X	X	X
T5		X	X	X	X	X	X	X	X	X	X
T6		X	X	X	X	X	X	X	X	X	X

	Course	Unit 11	Unit 12							
ISTE Standards										
T1		X	X							
T2		X	X							
T3		X	X							
T4		X	X							
T5		X	X							
T6		X	X							

T1 – Creativity and Innovation
T2 – Communication and Collaboration
T3 – Research and Information Fluency
T4 – Critical Thinking, Problem Solving, and Decision Making
T5 – Digital Citizenship
T6 – Technology Operations and Concepts

T1 – Creativity and Innovation

Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology. Students do the following:

a. Apply existing knowledge to generate new ideas, products, or processes.
b. Create original works as a means of personal or group expression.
c. Use models and simulations to explore complex systems and issues.
d. Identify trends and forecast possibilities.

T2 Communication and Collaboration

Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others. Students do the following:

a. Interact, collaborate, and publish with peers, experts, or others employing a variety of digital environments and media.
b. Communicate information and ideas effectively to multiple audiences using a variety of media and formats.
c. Develop cultural understanding and global awareness by engaging with learners of other cultures.
d. Contribute to project teams to produce original works or solve problems.

T3 Research and Information Fluency

Students apply digital tools to gather, evaluate, and use information. Students do the following:

a. Plan strategies to guide inquiry.
b. Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media.
c. Evaluate and select information sources and digital tools based on the appropriateness to specific tasks.
d. Process data and report results.

T4 Critical Thinking, Problem Solving, and Decision Making

Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources. Students do the following:

a. Identify and define authentic problems and significant questions for investigation.
b. Plan and manage activities to develop a solution or complete a project.
c. Collect and analyze data to identify solutions and/or make informed decisions.
d. Use multiple processes and diverse perspectives to explore alternative solutions.

T5 Digital Citizenship

Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior. Students do the following:

a. Advocate and practice safe, legal, and responsible use of information and technology.
b. Exhibit a positive attitude toward using technology that supports collaboration, learning, and productivity.
c. Demonstrate personal responsibility for lifelong learning.
d. Exhibit leadership for digital citizenship.

T6 Technology Operations and Concepts

Students demonstrate a sound understanding of technology concepts, systems, and operations. Students do the following:

a. Understand and use technology systems.
b. Select and use applications effectively and productively.
c. Troubleshoot systems and applications.

~~d. Transfer current knowledge to learning of new technologies.~~