

*it*WORKS.OHIO

Information Technology
Career Field Technical Content Standards
with
Academic Content Standards in
English Language Arts and Mathematics

2005-2006



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FOREWORD

itWORKS.OHIO, the career field technical content standards documents for information technology (IT), serves as the curricular framework for Ohio College Tech Prep and Career-Technical Education programs in information technology. This document reflects the career field framework outlined in Ohio Administrative Code 3301-61-03 and is a revised version of the original *itWORKS* completed in 1999.

The development of this document was a collaborative effort of the following professional partners: the Ohio Department of Education's Office of Career-Technical and Adult Education, the Ohio Board of Regents, the College Tech Prep Curriculum Service Center at the University of Toledo and the Ohio Resource Center at The Ohio State University. Over 100 secondary and postsecondary educators, along with business and industry professionals, participated in the development of this document. Contributing participants and their roles are listed in the section entitled, "Development of *itWORKS.OHIO*."

Information technology is the study, design, development, implementation, support and/or management of computer-based information systems, particularly software applications and computer hardware (Information Technology Association of America). Ohio's Information Technology Career Field includes occupations that focus on the design, development, support and management of hardware, software, multimedia and systems integration services. *itWORKS.OHIO* is comprised of four pathways leading to technically-based, professional-level careers in:

- Information Support and Services;
- Network Systems;
- Programming and Software Development; and
- Interactive Media.

itWORKS.OHIO delineates competencies that outline the knowledge and skills needed for career success in IT in the above four pathways. This document includes: a) core competencies that span the IT career field addressing critical workplace skills including technical skills, business processes, problem solving and critical thinking, and leadership and teamwork skills needed by IT professionals; and b) pathway competencies that describe specific occupational knowledge and skills.

In addition, benchmarks from the Ohio Academic Content Standards for Mathematics and English Language Arts have been embedded, outlining the mathematics and language arts knowledge and skills that are associated with specific technical competencies.

itWORKS.OHIO seeks to provide the basis for educational programming that will foster the development of what Doug Bush, Intel Corporation vice president and chief information officer, refers to as the "T-shaped" employee. The T-shaped employee combines broad knowledge, insight and understanding of business processes, academic attainment and workplace readiness (the crossbar of the "T") with depth of knowledge and expertise in a career specialty (the post of the "T"). The T-shaped employee is needed to ensure that Ohio's IT workforce of tomorrow is competitive in a global environment that requires specialization skills in a broader context aimed at the innovation of new products and services in an ever-changing economy.

itWORKS.OHIO is the basis for the development of an integrated delivery system that provides opportunities for new and challenging programs and courses. It is hoped that the document will enhance and expand career-technical education, College Tech Prep, and postsecondary degree programs in information technology.

The document is available on the Internet at www.techprepohio.com and www.itworks-ohio.org.

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ACKNOWLEDGEMENTS

A number of individuals contributed their time and expertise to this revision of *itWORKS.OHIO*. Special thanks go to all the business representatives and educators named in the section entitled, *Development of itWORKS.OHIO*. Further acknowledgement is due to:

- Sara Mazak, Information Technology Career Field Consultant, Office of Career-Technical and Adult Education, Ohio Department of Education, for her leadership in engaging business and educator professionals, providing direction based on her past experience spearheading the initial *itWORKS.OHIO*, contributing to the clarity and quality of this document through careful review and descriptive text, and providing assistance to education providers in the implementation of *itWORKS.OHIO*.

Also, acknowledgement is due to:

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The individuals listed above provided vision and implementation support for *itWORKS.OHIO* and Ohio's Information Technology educational programs.

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The people listed above contributed significant research and writing expertise and facilitated the lengthy and complex *itWORKS.OHIO* development project.

DEVELOPMENT OF *itWORKS*.OHIO

The process for the development of this version of *itWORKS*.OHIO began in August 2004 with the convening of a futuring panel and culminated in June 2005 with the work of a panel of business representatives and educators focusing on academic correlation. Over the course of the 2004-05 academic year, numerous business and industry representatives, as well as secondary and postsecondary educators from across the state of Ohio, took part in the formal development process. The following summarizes the various stages of the development process.

Futuring Panel

August 2004

The IT futuring panel brought together 21 key business and industry representatives from across the state to advise the Ohio Department of Education and the Ohio Board of Regents on future trends impacting the IT Career Field and to suggest ways in which these trends could be incorporated into a revised *itWORKS*.OHIO document. The panel meeting began with an address by Governor Bob Taft, who had announced the development of the original *itWORKS* in 1999.

Editing Panel

August – October 2004

Based on guidance provided by the futuring panel, the editing panel met at various locations across the state, where they reviewed and made editorial changes and updated content to the 1999 edition of *itWORKS*.

Business Review Panel

October and November 2004

Over 50 Ohio business and industry representatives participated in this panel. Drawn from diverse industrial sectors and regions of the state, the panel identified what IT employees should know and be able to do in four areas of IT: Information Support and Services, Network Systems, Programming and Software Development, and Interactive Media. The panel built upon work outlined in *itWORKS*.OHIO, as revised by the editing panels, identifying essential and recommended knowledge and skills.

Business Process Panel

November 2004

This panel of business representatives was charged with identifying core business process skills needed by IT professionals across the four IT pathways. This panel drafted specific competency statements for inclusion in the *itWORKS*.OHIO career field document.

Educator Review Panel

December 2004

This panel was composed of representatives from secondary and postsecondary institutions across Ohio with an existing pathway in IT. The panel determined *when* in the educational process (e.g., high school or college) competencies should be addressed and to *what depth*. In addition, the educator panel noted questions they had on decisions made by the business review panel and formulated suggestions for additions, deletions and editorial changes to the draft document.

Stakeholder Review Panel

January 2005

The stakeholder panel brought together representatives from the business review and business process panels to meet with representatives from the educator review panel in order to address issues raised by educators in the December meeting and also to review the document to ensure that it provides a cohesive and deliverable set of competencies for IT professionals at both secondary and postsecondary exit points. In addition, both business representatives and educators reviewed and leveled the business process units drafted by the business process panel. The panel provided a forum to ensure that the final document facilitates the seamless education of students interested in pursuing a career in Information Support and Services, Network Systems, Programming and Software Development, and Interactive Media.

Academic Review Panel

June 2005

The academic review panel brought together business representatives, secondary and postsecondary technical educators with academic educators to identify benchmarks from the Ohio Academic Content Standards for Mathematics and English Language Arts that are embedded within the technical competencies. This incorporation of academic content standards with career field technical content standards provides an opportunity for instructional integration of content, helping to contextualize learning for students and providing the basis for collaboration across disciplines.

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itWORKS.OHIO Academic Review Panel
June 2005

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PHILOSOPHY AND PRINCIPLES FOR IMPLEMENTATION

Ohio Career Field Initiative

The overarching framework for career-technical education in Ohio is outlined in the Ohio Revised Code and subsequent administrative rules, which specify career-technical programming based on 16 career fields. To view the full text of the rule, go to: www.ode.state.oh.us/ctae/regulations/admin_rules.asp These fields provide the framework for an Ohio Career Field Initiative that seeks to foster the educational shift needed to respond to the needs of a rapidly changing global environment.

A career field is a “grouping of occupations and broad industries based on commonalities” (see www.careercluster.org). Career fields are the basis for developing both broad and specialized technical content standards that serve as a framework for curriculum, instruction, assessment and program design, addressing the needs of an entire industry and business sector. Ohio’s 16 career fields align with national efforts to broaden career-technical education, integrate career-technical with academic study and reflect the workforce needs of today and tomorrow. For today’s students to be adequately prepared for tomorrow’s workforce, they must have an education that:

- 1) **incorporates a broad, long-term conception of work in combination with the depth of specialization skills;**
 - Employees need a comprehensive understanding beyond a single occupational area. Occupationally focused programming needs to be provided in a larger context, so students can generalize learning, make connections between education and work, and adapt to changes in their careers. Workplace knowledge and skills are needed to prepare employees for collaboration and problem solving while contributing to the broader business process.
- 2) **emphasizes the acquisition of strong academic knowledge and skills; and**
 - Academic skills provide the foundation for career success. The integration of academic content standards with career field technical content standards helps to contextualize learning for students, making mathematics and English language arts relevant to students as a means to an important end—success at work and in life.
- 3) **facilitates high school to-postsecondary transitions.**
 - A lifetime of change means a lifetime of learning, including postsecondary education. Students need knowledge and skills for success in a variety of postsecondary options, including apprenticeships, industry credentialing through adult education, two- and four-year college degree programs, and graduate school.

Ohio Career Field Technical Content Standards

Career field technical content standards outline the knowledge and skills needed for success within a career field, multiple pathways and, in some cases, areas of specialization. Validated by Ohio business and industry representatives in conjunction with Ohio educators, these standards are the basis for the development of educational programming in Ohio secondary and postsecondary schools. The standards also serve as the framework for developing strong career pathways that connect secondary, adult and postsecondary education systems with the workplace.

While mirroring the diverse nature of each career field, all career field technical content standards documents will delineate competencies that outline the knowledge and skills that span the career field (core competencies), as well as those that relate to specific career field pathways (pathway competencies) and, in some cases, career field specialization (specialization competencies).

Additionally, academic benchmarks from the Ohio Academic Content Standards for mathematics and English language arts are correlated with the career field technical content standards. The embedded benchmarks have been determined by business representatives and academic and technical educators from secondary and postsecondary institutions to be strongly related to specific knowledge and skills statements or competencies for the given career field.

Key features of Ohio Career Field Technical Content Standards include:

1. Broad as well as specialized technical competencies;
2. Embedded benchmarks for the Mathematics and English Language Arts Academic Content Standards; and
3. Workplace readiness competencies (communications; safety, health and environment; problem solving and critical thinking; leadership, management and teamwork; information technology applications; ethics and legal responsibility; business systems; and career development and employability).

Career Pathways

A key component of the Ohio Career Field Initiative is a career pathway: a series of academic and technical career-focused coursework and other educational learning experiences leading to a career specialty and employment in a career field. Pathways facilitate a seamless transition from high school to postsecondary education (including apprenticeships, adult education, two- and four-year colleges, and graduate school) and from postsecondary education to the workplace.

To effectively facilitate the transition from secondary to postsecondary education and a career, high school career pathways should encompass:

1. Challenging technical course work in a chosen career field, based on career field technical content standards;
2. Rigorous academics that meet Ohio academic content standards and grade-level expectations;
3. Electives that relate to career objectives;
4. Instructional enhancements, such as experiential and authentic learning opportunities (e.g., work-based learning, mentorships, internships) and career-technical student organization participation;
5. Opportunities (when appropriate) for program and student certification and licensure;
6. Preparation for transition to further study that includes college readiness and opportunities to earn college credit while in high school;
7. Preparation for transition to employment with advancement opportunities; and
8. Performance targets that include both high school academic and technical testing/exit requirements and postsecondary entry/placement requirements.

For additional information on the Career Field Initiative, including Ohio Career Field Technical Content Standards and Career Pathways, go to www.ode.state.oh.us/ctae.

**The Ohio College Tech Prep Advisory Council developed the following standards in May 2002. Please note that new Ohio Career Field Technical Content Standards will replace the Tech Prep Competency Profiles (TCPs) referred to in the document. As these are developed, they will serve as the basis for College Tech Prep program development in those pathways approved as College Tech Prep.*

All pathways in the **itWORKS.OHIO** document are College Tech Prep approved.

COLLEGE TECH PREP PROGRAM STANDARDS

College Tech Prep programs are rigorous programs of study starting at the secondary school level and continuing through the associate degree and beyond. In accordance with the Carl D. Perkins Vocational Technical Education Enhancement Act of 1998, College Tech Prep programs are seamless, non-duplicative programs of study combining high-level academic and technical preparation in a variety of career fields.

The Carl D. Perkins Vocational and Technical Education Act of 1998 defines College Tech Prep as:

A program that provides technical preparation in a career field such as engineering, applied science, mechanical, industrial or practical arts or trade, agriculture, health occupations, business or applied economics, and must do the following:

- *Combines at least two years of secondary and two years of postsecondary education in a sequential course of study without duplication of course work;*
- *Integrates academic, vocational and technical education, and if appropriate and available, work-based learning;*
- *Provides technical preparation for careers;*
- *Leads to an associate or a baccalaureate degree or postsecondary certificate in a specific career field;*
- *Leads to placement in appropriate employment or further education.*

The Ohio College Tech Prep Advisory Council recommended to the Ohio Board of Regents and the Ohio Department of Education the following standards for all College Tech Prep programs:

- Academics are taught at a college-preparatory level and are aligned with state models and academic content standards.

In addition to Ohio graduation requirements specified in SB 55, required academic components for College Tech Prep programs include:

- Mathematics taught to a minimum level of Algebra II by the completion of high school;
- An integrated or stand-alone senior-year math component;
- Three units of science, including at least two lab-based science courses;
- College Tech Prep programs will use a state-developed Technical Competency Profile (TCP)* as the basis for pathway development. The pathway document should reflect secondary and postsecondary course work and should be made available for stakeholders. All secondary and postsecondary TCP competencies must be clearly identified and addressed. The TCP is the framework used to develop all associated curricular documents; however, components from other competency profiles, such as OCAPs (Occupational Competency Analysis Profile), ITACs (Integrated Technical and Academic Competencies) and SCANS (The Secretary's Commission on Achieving Necessary Skills—America 2000), may be included and are not mutually excluded from a TCP;

- Articulated pathways will be reviewed every two-years at the consortia level;
- Pathways operate under an articulation agreement between or among partners in a consortium;
- College Tech Prep programs at the secondary level will operate as state-approved career-technical education programs;
- Academic and technical instruction is integrated and delivered in a contextual approach, where possible;
- Programs have common representation from secondary education, higher education, business and labor members;
- Postsecondary programs contain advanced skills in the TCP document;*
- Programs must operate under either regionally accredited postsecondary institutions and degrees or approved apprenticeship programs meeting U.S. Department of Labor standards; and
- College Tech Prep programs, both secondary and postsecondary, must comply with the state College Tech Prep Advisory Council's performance measures.

State College Tech Prep Advisory Council
Revised and Approved: May 1, 2002

STRUCTURE AND FORMAT

itWORKS.OHIO is composed of a series of units, competencies and descriptors:

- *Units* are a grouping of competencies sharing a common subject or theme (a listing of units can be found in the Table of Contents);
- *Competencies* are specific knowledge and skill statements which outline the knowledge and skills needed for career success; and
- *Descriptors* follow each competency and serve to define what is meant by the related competency.

Also included in the document are selected benchmarks from the Ohio Academic Content Standards for Mathematics and English Language Arts, which are correlated with specific technical competencies. This incorporation of academic content standards with career field technical content standards provides an opportunity for instructional integration of content, helping to contextualize learning for students and providing the basis for collaboration across disciplines.

Competencies that are common across the career field and/or that are critical for success in the Information Technology Career Field are referred to as core competencies. These core competencies represent the sustaining characteristics of a career field and facilitate career readiness and long-term career success by:

- Providing the basis for effective collaboration, teamwork and communication across pathways;
- Laying the groundwork for successful transfer of knowledge and skills across pathways, thereby facilitating horizontal and vertical career success; and
- Equipping students and workers with the skills needed to transition to new and emerging careers throughout a working lifetime.

In *itWORKS.OHIO*, core competencies include those focusing on:

- Information Technology Basics;
- Business Processes for IT Professionals;
- Business Law and Legal Issues;
- Technical Writing and Documentation;
- Professional Practices; and
- Basic Business Concepts.

Pathway competencies are specific to one or several pathways within a larger career field. They differentiate the academic, technical and workplace knowledge and skills that are more specific than those that are relevant to the entire career field, yet they prepare students for multiple occupational specialties.

itWORKS.OHIO is built around the following four pathways:

- **Information Support and Services;**
- **Network Systems;**
- **Programming and Software Development; and**
- **Interactive Media.**

Core and pathway competencies form the basis for developing secondary and postsecondary programs, facilitating transition from one educational level to the next and to the workplace.

In *itWORKS.OHIO*, competencies have been designated as *essential* or *recommended* by business representatives on the basis of specific pathways, with educators designating *when* (by the end of the 10th grade, 12th grade and/or associate degree) and *to what depth* (introduced, reinforced, proficient) competencies should be addressed. Definitions used to make these designations appear on the following page, followed by a sample competency illustrating the layout of an actual competency.

DEFINITIONS AND CODES

Determined by Business, Industry and Labor Panel (BIL)

Pathways or Occupational Strand Areas:

ISS	=	Information Support and Services
NS	=	Network Systems
PSD	=	Programming and Software Development
IM	=	Interactive Media

Essential (E) Competency:

E = Competency is needed to ensure minimal level of employability. Entry-level employees (defined as graduates of an associate degree program) should be able to perform this competency for career success.

Recommended (R) Competency:

R = Competency should be included but is not essential for minimal level of employability or is related only to a subspecialty within a strand.

Determined by Educator Panel (EDU)

Grade Level:

10	=	by the end of grade 10
12	=	by the end of grade 12
AD	=	by the end of the associate degree program

Depth:

I	=	Introduce competency (<i>all “essential” competencies – items to be introduced prior to the end of the 12th grade are indicated by the presence of an occupational area code following the descriptor</i>)
R	=	Reinforce, or add depth after introducing a competency, OR after proficiency
P	=	Proficient or achievement of the competency; ability to apply knowledge of and/or perform the competency

Determined by Academic Review Panel

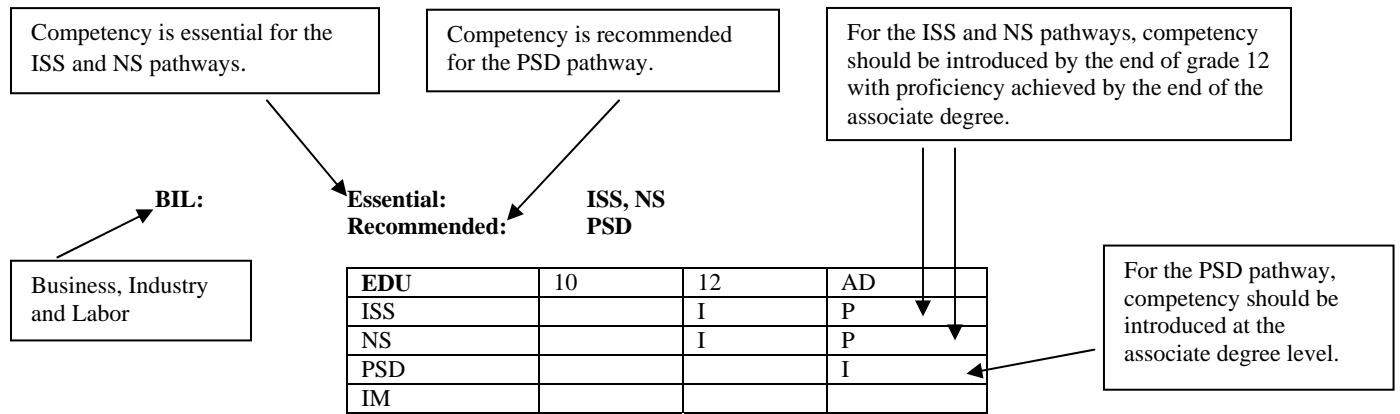
Correlated English Language Arts Academic Content Benchmarks

Benchmarks drawn from the *Ohio Academic Content Standards for English Language Arts* that have been determined to be embedded in corresponding technical competency.

Correlated Mathematics Academic Content Benchmarks

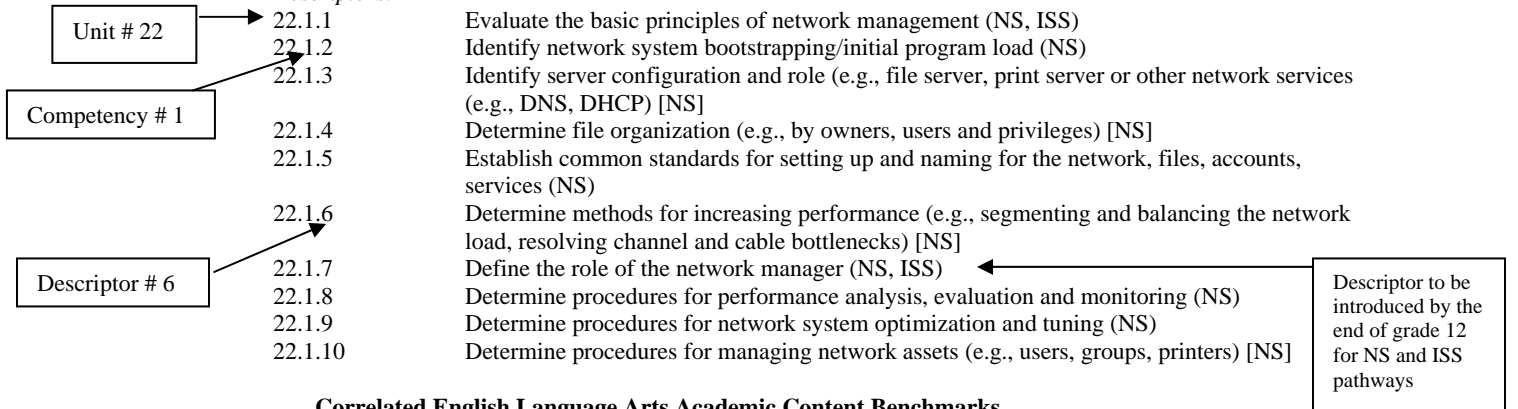
Benchmarks drawn from the *Ohio Academic Content Standards for Mathematics* that have been determined to be embedded in the corresponding technical competency.

SAMPLE COMPETENCY



Competency 22.1: Demonstrate knowledge of network management activities and procedures

Descriptors:



- 22.1.1 Evaluate the basic principles of network management (NS, ISS)
- 22.1.2 Identify network system bootstrapping/initial program load (NS)
- 22.1.3 Identify server configuration and role (e.g., file server, print server or other network services (e.g., DNS, DHCP) [NS])
- 22.1.4 Determine file organization (e.g., by owners, users and privileges) [NS]
- 22.1.5 Establish common standards for setting up and naming for the network, files, accounts, services (NS)
- 22.1.6 Determine methods for increasing performance (e.g., segmenting and balancing the network load, resolving channel and cable bottlenecks) [NS]
- 22.1.7 Define the role of the network manager (NS, ISS)
- 22.1.8 Determine procedures for performance analysis, evaluation and monitoring (NS)
- 22.1.9 Determine procedures for network system optimization and tuning (NS)
- 22.1.10 Determine procedures for managing network assets (e.g., users, groups, printers) [NS]

Correlated English Language Arts Academic Content Benchmarks

- Compile, organize and evaluate information, take notes and summarize findings. (Research B, 11-12)
- Evaluate the usefulness and credibility of data and sources, and synthesize information from multiple sources. (Research C, 11-12)

Correlated Mathematics Academic Content Benchmarks

- Model and solve problem situations involving direct and inverse variation (Algebra I, 8-10)
- Formulate a problem or mathematical model in response to a specific need of situation, determine information required to solve the problem, choose method for obtaining this information, and set limits for acceptable solution. (Math. Process A, 8-10)
- Locate and interpret mathematical information accurately, and communicate ideas, processes and solutions in a complete and easily understood manner. (Math. Process H, 8-10)

Benchmarks from the English Language Arts Content Standards

PATHWAY DEFINITIONS

- **Information Support and Services (ISS)**
- **Network Systems (NS)**
- **Programming and Software Development (PSD)**
- **Interactive Media (IM)**

Information Support and Services (ISS)

The Information Support and Services program area will prepare students for careers dealing with information technology (i.e., operations, support, deployment/integration). Students will gain the necessary skills to implement computer systems and software, provide technical assistance and manage information systems. Skills needed to acquire certifications will be an integral part of this program. Essential skill areas include but are not limited to:

Communication Skills, Written and Verbal
Customer Service
Problem Solving and Critical Thinking
Security
General Computer Usage Skills
Management of Information Systems
Overall Use of the Network System
Basic Programming
Basic Software Development
Basic Interactive Multimedia Development
Business Skills
Management Skills

Sample list of job titles:

Computer Operators
IS Operator/Analyst
Computer Operations Technician
Operations Scheduler
Data Analyst
Database Systems Administrator
Customer Service Representative
Technical Support Engineer
Product Support Engineer
Call Center Support Representative
Help Desk Technician
Technical Support Representative
Technical Sales Consultant
PC Support Specialist
PC Technician
Technical Writer
Software Application Specialist
LAN Applications Support Analyst
Lead Customer Service Coordinator
Systems Administrator
Trainer
Information Architect
Desktop Architect

Network Systems (NS)

The Network Systems program area will prepare students for careers dealing with network systems analysis, planning and implementation. Students will gain the necessary skills to analyze network system needs for the design, installation, maintenance and management of network systems. Skills acquired will assist students to obtain network certifications. Essential skill areas include but are not limited to:

- Operations
- Network Administration
- Basic Network Design Theory
- Network Troubleshooting
- Network Security
- Network Operations Center
- Computer Hardware Maintenance
- Network Management

Sample list of job titles:

- Network Specialist
- Network Operations Analyst
- Communications Analyst
- Network Analyst
- Cable Installer
- Local Area Network Technician
- Network Administration
- Network Maintenance and Operations
- Hardware Support/Maintenance
- Network Administrator
- Telecommunications Technician
- Wide Area Network Technician
- Customer Service Coordinator
- Hardware Installations Coordinator
- Network Technician

Programming and Software Development (PSD)

Students training in the areas of hardware and software programming and analysis will learn to design, develop, test, document, implement and maintain computer systems and software. Students will select from program specialties that will lead to computer training in computer operating systems, programming languages, software development, and application and software maintenance. Essential skill areas include but are not limited to:

- Computer System Architecture
- Programming Analysis
- Software Design
- Application/Operating System Programming
- Graphical User Interfaces (GUI)
- Web Design Utilization
- Computer Application Development and Implementation

Sample list of job titles:

- Systems Analyst
- Programmer Analyst
- Operating Systems Specialist
- Software Designer
- Software Applications Specialist
- Test Specialist
- Software/Application Support
- Entry (Junior Level) Programmer
- Senior Level Programmer
- Software Architect
- Software Engineer
- Application Database Developer
- Desktop Database Technician

Interactive Media (IM)

Students training in the area of interactive media will become competent in creating, designing and producing interactive multimedia products and services. This program of study emphasizes the development of digitally-generated or computer-enhanced media. Students will use multimedia technology to develop products and programs for business, training, entertainment, communications and marketing. Essential skill areas include but are not limited to:

- Animation
- Media Design
- Interactive Digital Media
- Graphical User Interfaces (GUI)
- Instructional Application
- Application Design
- Authoring Languages
- Audio/Visual Production
- Digital Imaging
- Assessment/Evaluation
- Marketing
- Network (Basic and Storage)
- Personal Information Privacy

Sample list of job titles:

- Usability Specialist
- Digital Asset Manager
- Animator
- Imaging Specialist
- Audio/Visual Specialist
- Media Designer
- Multimedia Specialist
- Production Assistant
- Interactive Digital Media Specialist
- 3-D Designer
- Web Designer
- Graphic Designer
- Multimedia Programmer
- Graphics Technician
- Visual Design Consultant
- Web Content Designer
- Instructional Designer
- Writer
- Project Manager
- Multimedia Technician
- Quality Assurance Technician
- Video Specialist
- Web Development Programmer

Competency Summary 2006 *itWORKS*.OHIO

ISS = Information Support and Services	PSD = Programming and Software Development/ Applications
NS = Communication Network Services	IM = Interactive Multi-Media Development
E = Essential Competency is needed to ensure minimal level of employability. Entry level employees (graduates of an associate degree program) should be able to perform this competency for career success.	
R = Recommended Competency should be included but is not essential for minimal level of employability.	

Competency		ISS	NS	PSD	IM
Unit 1: Information Technology Basics					
1.1	Demonstrate basic knowledge of information technology history	E P-10	E P-10	E P-10	E P-10 R-12 R-AD
1.2	Demonstrate basic knowledge of the information technology impact on society	E P-10	E P-10	E P-10	E P-10 R-12 R-AD
1.3	Demonstrate knowledge of information technology basics	E P-10	E P-10	E P-10	E P-10 R-12 R-AD
1.4	Demonstrate knowledge of software associated with information technology	E P-10	E P-10	E P-10	E P-10 R-12 R-AD
1.5	Evaluate career opportunities in information technology	E P-10	E P-10	E P-10	E P-10 R-12 R-AD
1.6	Explore the future of information technologies	E P-10	E P-10	E P-10	E P-10 R-12 R-AD
1.7	Create documents using word processing software	E P-10	E P-10	E P-10	E P-10 R-12
1.8	Create relational databases	E P-10	E P-10	E P-10	E P-10
1.9	Create spreadsheets	E P-10	E P-10	E P-10	E P-10

Competency		ISS	NS	PSD	IM
1.10	Create presentations using presentation graphics	E P-10	E P-10	E P-10	E P-10 R-12 R-AD
1.11	Apply computer office tools	E P-10	E P-10	E P-10	E P-10, R-12 R-AD
1.12	Demonstrate knowledge of basic data communications components and trends	E P-10	E P-10	E P-10	E P-10 R-12 R-AD
1.13	Evaluate and access information using electronic sources	E P-10	E P-10	E P-10	E P-10 R-12 R-AD
1.14	Demonstrate proficiency with electronic mail and instant messaging	E P-10	E P-10	E P-10	E P-10
1.15	Install/configure software programs	E P-10	E P-10	E P-10	E P-10
1.16	Demonstrate basic knowledge of the Internet	E P-10	E P-10	E P-10	E P-10 R-12 R-AD
1.17	Access the Internet	E P-10	E P-10	E P-10	E P-10 R-12 R-AD
1.18	Utilize Internet services	E P-10	E P-10	E P-10	E P-10 R-12 R-AD
1.19	Demonstrate knowledge of Web page basics	E P-10	E P-10	E P-10	E P-10 R-12 R-AD
1.20	Install computer system (e.g., monitor, keyboard, disk drive, and printer)	E P-10	E P-10	E P-10	E P-10
Unit 2: Operating Systems					
2.1	Explain operating systems	E 1-10 R-12 P-AD	E P-12 R-AD	E I-12 P-AD	E I-12 P-AD
2.2	Describe computer memory utilization	E I-12 P-AD	R I-12 P-AD	E I-12 P-AD	E I-12 P-AD

Competency		ISS	NS	PSD	IM
2.3	Implement and maintain security compliance	E I-12 P-AD	E I-12 P-AD	E I-12 P-AD	
2.4	Apply systems operations procedures	E I-12 P-AD	E I-12 P-AD		
2.5	Maintain and respond to system needs	E I-12 P-AD	E I-12 P-AD	R I-12 R-AD	
2.6	Perform standard computer backup procedures	E P-12 R-AD	R I-12 P-AD	R I-12 R-AD	E I-12 P-AD
Unit 3: Software Systems Management					
3.1	Perform configuration management activities	E I-12 P-AD	E P-AD	E I-12 P-AD	
3.2	Evaluate application software packages	E I-12 P-AD	E P-AD	E I-12 P-AD	E I-12 P-AD
Unit 4: Computer User Support					
4.1	Analyze technical support needed	E I-12 P-AD	E I-12 P-AD	R I-AD	
4.2	Perform customer service	E I-12 P-AD	E I-12 P-AD		
4.3	Provide support and training	E I-12 P-AD	E I-12 P-AD	R I-AD	
Unit 5: Programming Theory					
5.1	Demonstrate knowledge of programming language concepts	R I-12 R-AD		E I-10 P-12 R-AD	R I-12 P-AD
5.2	Apply software design techniques	R I-12 R-AD		E I-12 P-AD	R I-12 P-AD
5.3	Identify models of application	R I-12 R-AD		E I-10 P-12 R-AD	R I-12 P-AD
Unit 6: Applied Programming Languages					
6.1	Demonstrate knowledge of computational and String operations	R I-12 R-AD		E I-10 P-12 R-AD	

Competency		ISS	NS	PSD	IM
6.2	Demonstrate knowledge of logical operations and control structures	R I-12 R-AD		E I-10 P-12 R-AD	
6.3	Use integrated development environment to build a program	R I-12 R-AD		E I-10 P-12 R-AD	
6.4	Debug programs	R I-12 R-AD		E I-10 P-AD	
6.5	Develop programs by applying specialized techniques and tools	R I-12 R-AD		R I-10 P-12	
Unit 7: Software Development Overview					
7.1	Demonstrate knowledge of software development methodology	R I-AD		E I-12 P-AD	
7.2	Demonstrate knowledge of basic software systems design	R I-AD		E I-12 P-AD	
7.3	Develop software requirements/specifications	E P-AD		E I-12 P-AD	
7.4	Code programs			E I-10 R-12 P-AD	
7.5	Execute software testing, validation, change control, defect tracking, and documentation	R I-12 R-AD		E I-10 R-12 P-AD	
7.6	Demonstrate knowledge of data structures			E I-12 P-AD	
Unit 8: Application Development Life Cycle					
8.1	Conduct requirements analysis	E P-AD		E I-10 R-12 P-AD	
8.2	Develop system framework			E I-10 R-12 P-AD	
8.3	Design applications			E I-12 P-AD	

Competency		ISS	NS	PSD	IM
8.4	Develop a series of programs that interact with one another in accordance with programming theory and software development techniques to solve the business problem			E I-10 R-12 P-AD	
8.5	Develop a system test plan			E I-12 P-AD	
8.6	Develop user application documentation	E I-12 P-AD		E I-12 P-AD	
8.7	Install application	E P-AD		E I-12 P-AD	
8.8	Execute software product release and follow-up	R P-AD	R I-12 P-AD	E I-12 P-AD	
8.9	Complete team software engineering project	R P-AD	R I-12 P-AD	R I-AD	
8.10	Apply quality standards	R P-AD	R I-12 P-AD	E I-12 P-AD	
Unit 9: Web Site Development and Management					
9.1	Demonstrate knowledge of HTML fundamentals			E P-10 R-12 R-AD	
9.2	Develop an Internet program			E I-10 P-12 R-AD	
9.3	Demonstrate knowledge of content management			E I-10 P-12 R-AD	
9.4	Demonstrate knowledge of Web application management			E I-12 P-AD	
9.5	Integrate scripting into an HTML document		R I-AD	R I-AD	
Unit 10: Web Site Development and Management – HTML Fundamentals					
10.1	Create a basic HTML document	R I-10	R I-AD		
10.2	Demonstrate knowledge of graphics and multimedia	R I-12	R I-AD		

Competency		ISS	NS	PSD	IM
10.3	Link Web documents	R I-10 R-12 R-AD	R I-AD		
10.4	Utilize forms in an HTML document	R I-10 R-12 R-AD	R I-AD		
10.5	Create and format a table on an HTML document	R I-12	R I-AD		
Unit 11: Web Site Development: Content Development and Technical Analysis					
11.1	Gather data and identify customer requirements and scope of work				E P-12 R-AD
11.2	Review technical information and restraints				E I-12 P-AD
11.3	Develop, present, and assess concept alternatives				E I-12 P-AD
11.4	Prepare preliminary application				E I-12 P-AD
11.5	Prepare functional, content, testing and technical specifications				E I-12 P-AD
11.6	Create and refine preliminary design or prototype				E I-12 P-AD
11.7	Develop project plan				E I-12 P-AD
Unit 12: Web Site Development: Develop and Design Web Applications and Sites					
12.1	Develop Web site architecture, application models and user interface specifications				R I-12 P-AD
12.2	Choose an architecture				R I-12 P-AD
12.3	Select programming languages, design tools and applications				R I-12 P-AD
12.4	Write supporting code				R I-12 P-AD

Competency		ISS	NS	PSD	IM
12.5	Analyze major subsystems and interfaces				R I-12 P-AD
12.6	Develop models				R I-12 P-AD
12.7	Develop design and interface specifications				R I-12 P-AD
12.8	Identify system platform components and dependencies				R I-12 P-AD
12.9	Link and develop supporting database				R I-12 P-AD
Unit 13: Implement and Maintain Applications					
13.1	Plan rollout and facilitate handoff to customer	R I-12 R-AD			
13.2	Integrate customer feedback	R I-12 R-AD			
13.3	Perform application maintenance	R I-12 R-AD			
13.4	Recommend optimization and facilitate upgrades and improvement	R I-12 R-AD			
13.5	Administer content	R I-12 R-AD			
13.6	Document application and site changes as it applies to the system environment and application version	R I-12 R-AD			
13.7	Monitor performance metrics	R I-12 R-AD			
13.8	Implement and support changes in new technology	R I-12 R-AD			
Unit 14: Multimedia Development: Performance Testing and Quality Assurance					
14.1	Develop test and acceptance plan				R I-12 P-AD
14.2	Develop test procedures and performance assessment requirements				R I-12 P-AD

Competency		ISS	NS	PSD	IM
14.3	Develop and perform usability and testing integration				E I-12 P-AD
14.4	Complete performance test process				E I-12 P-AD
14.5	Recommend and implement performance improvement				R I-12 P-AD
14.6	Provide quality customer service				R I-12 P-AD
Unit 15: Basic Mainframe Concepts					
15.1	Demonstrate knowledge of enterprise systems	R I-12 R-AD		E I-12 P-AD	
15.2	Design multi-tiered applications			R I-AD	
15.3	Set up mainframe database systems			R I-AD	
15.4	Operate mainframe computer systems	R I-AD		R I-AD	
15.5	Maintain mainframe computer systems	R I-AD		R I-AD	
Unit 16: Hardware Design, Operation, and Maintenance					
16.1	Demonstrate proficiency in working with microcomputer systems	E P-12 R-AD	E P-12 R-AD		
16.2	Demonstrate proficiency in working with basic computer system architecture	E P-12 R-AD	R P-12 R-AD		
16.3	Explain the purpose and importance of hardware standards	E P-12 R-AD	E I-10 P-12 R-AD		
16.4	Identify common computing platforms	E P-12 R-AD	E P-12 R-AD		E I-12 P-AD
16.5	Analyze the computer site environment	R I-12 R-AD	E I-12 P-AD		
16.6	Classify computer architecture and processor types	E P-12 R-AD	E P-12 R-AD	R I-AD	
16.7	Classify computer systems	E P-12 R-AD	R I-12 R-AD	R I-12 R-AD	

Competency		ISS	NS	PSD	IM
16.8	Identify and explain CPU and system components	E P-12 R-AD	R P-12 R-AD	R I-AD	
16.9	Identify and describe connectivity devices	E P-12 R-AD	E P-12 R-AD	R I-AD	
16.10	Identify and describe peripheral equipment	E P-12 R-AD	E P-12 R-AD	R I-10 R-12 R-AD	
16.11	Evaluate cost and performance issues in designing, building or upgrading a computer system	E P-12 R-AD	E P-12 R-AD	R I-AD	
16.12	Troubleshoot computer systems	E I-12 P-AD	E I-12 P-AD		E I-12 P-AD
Unit 17: Fundamentals of Electronics Technology					
17.1	Demonstrate an understanding of electrical fundamentals		R I-12 R-AD		
17.2	Demonstrate knowledge of operating the various types of equipment used to test/measure DC circuits, AC circuits, solid-state devices, digital circuits, analog circuits, and microprocessors		R I-12 R-AD		
17.3	Demonstrate proficiency in working with DC circuits		R I-12 R-AD		
17.4	Demonstrate proficiency in working with AC circuits		E I-12 P-AD		
Unit 18: Networking					
18.1	Demonstrate knowledge of basic network classifications and topologies	E I-12 P-AD	E P-12 R-AD	R I-12 R-AD	
18.2	Demonstrate knowledge of local-area network trends and issues	E I-12 P-AD	E P-12 R-AD		
18.3	Demonstrate knowledge of network physical layer	E I-12 P-AD	E P-12 R-AD		
18.4	Demonstrate knowledge of network connectivity basics	E P-12 R-AD	E P-12 R-AD		
18.5	Demonstrate knowledge of protocol concepts	E I-12 P-AD	E P-12 R-AD	R I-AD	
18.6	Demonstrate knowledge of the Open Systems Interconnection (OSI) standard (ISO Standard 7498)	R I-12 R-AD	E P-12 R-AD		

Competency		ISS	NS	PSD	IM
18.7	Demonstrate knowledge of communication standards for networks	R I-12 R-AD	E P-12 R-AD		
18.8	Demonstrate knowledge of data encoding basics	R I-12 R-AD	E I-12 P-AD	R I-12 R-AD	
18.9	Demonstrate knowledge of IP addressing schemes	E I-12 P-AD	E P-12 R-AD	R I-AD	
Unit 19: Network Architectures					
19.1	Demonstrate knowledge of the basics of network architecture	E I-12 P-AD	E P-12 R-AD		
19.2	Demonstrate knowledge of the basics of Ethernet technology	E I-12 P-AD	E P-12 R-AD		
19.3	Demonstrate knowledge of the TCP/IP protocol suite details	E I-12 P-AD	E P-12 R-AD	R I-AD	
Unit 20: Network Operating Systems					
20.1	Demonstrate knowledge of the network operating systems characteristics	E I-12 P-AD	E P-12 R-AD		
20.2	Install and administer network operating system and services	E I-12 P-AD	E I-12 P-AD		
Unit 21: Wide-Area Networks					
21.1	Demonstrate knowledge of basic telecommunications and the interconnection of networks	E P-12 R-AD	E P-12 R-AD		R I-12 P-AD
21.2	Assess user needs for a wide-area network (WAN)	E P-AD	E P-12 R-AD		R P-AD
21.3	Design WAN systems	E I-12 P-AD	E I-12 P-AD		
Unit 22: Network Management					
22.1	Demonstrate knowledge of network management activities and procedures	E I-12 P-AD	E I-12 P-AD	R I-AD	
22.2	Demonstrate knowledge of network applications	E I-12 P-AD	E I-12 P-AD	R I-AD	
22.3	Solve network applications problems	E P-AD	E I-12 P-AD		

Competency		ISS	NS	PSD	IM
22.4	Perform network analysis, selection, and design	R I-12 R-AD	E I-12 P-AD		
22.5	Perform network installation procedures	R I-12 R-AD	E I-12 P-AD		
22.6	Perform network operation procedures	E I-12 P-AD	E I-12 P-AD		
22.7	Perform hardware and desktop support	E I-12 P-AD	E I-12 P-AD		
22.8	Perform network administration	R I-12 R-AD	E I-12 P-AD		
22.9	Perform network maintenance and diagnostics and testing	R I-12 R-AD	E I-12 P-AD		
22.10	Recommend disaster recovery and business continuity plans	R I-12 R-AD	E I-12 P-AD		
Unit 23: Security Fundamentals					
23.1	Examine the history and components of information assurance	E I-12 P-AD	E I-12 P-AD	E I-12 P-AD	E P-12 R-AD
23.2	Describe the components associated with computer and network security systems	E I-12 P-AD	E I-12 P-AD	R I-12 R-AD	
Unit 24: Secure Network Management					
24.1	Implement secure network management activities and procedures	R I-12 R-AD	E I-12 P-AD		
24.2	Describe risk analysis	R I-12 R-AD	E P-AD	R I-AD	
24.3	Explain information technology mechanisms as they apply to a multi-layer defense structure	R I-12 R-AD	E P-AD		
24.4	Explain communication in a WAN environment	E I-12 P-AD	E I-12 P-AD		
Unit 25: Wireless					
25.1	Explain wireless communications	E P-12 R-AD	E P-12 R-AD	R I-12 P-AD	E I-12 P-AD
25.2	Design and implement a wireless network solution	R I-AD	E I-12 P-AD		R I-12 P-AD

Competency		ISS	NS	PSD	IM
25.3	Evaluate security concerns specific to wireless networks and devices, and techniques for minimizing those risks	R I-AD	E I-12 P-AD		R I-12 P-AD
Unit 26: Telecommunications					
26.1	Demonstrate knowledge of transmission line applications	R I-12 R-AD	E I-12 P-AD		
26.2	Demonstrate knowledge of concepts and techniques used in working with communications systems	R I-12 R-AD	E I-12 P-AD		
26.3	Demonstrate knowledge of telecommunications networks	R I-12 R-AD	E I-12 P-AD		
Unit 27: Information Systems (IS) Theory					
27.1	Explain systems theory	E I-12 P-AD	E I-12 P-AD	E I-10 R-12 P-AD	
27.2	Define the information system infrastructure	E P-AD	E P-AD	E I-12 P-AD	
27.3	Select systems development approach	R I-AD	E P-AD	R I-AD	
27.4	Compare/contrast individual and collaborative knowledge work	E P-AD	R P-AD	R I-AD	
27.5	Evaluate strategies for implementing systems	E I-12 P-AD	R P-AD	R I-AD	
27.6	Measure achievement	E P-AD	R P-AD	R I-AD	
Unit 28: Information Systems					
28.1	Develop and implement organizational planning for information systems	R I-AD		R I-AD	
28.2	Establish how information systems will be developed and managed within the organization	E I-12 P-AD		R I-AD	
28.3	Perform IS functions	E P-AD		R I-AD	
28.4	Assess and manage IS subfunctions	R I-AD		R I-AD	
28.5	Apply management principles to IS functions			R I-AD	
Unit 29: Information System Analysis and Design					
29.1	Evaluate the role of systems analysts	E I-12 P-AD		R I-AD	

Competency		ISS	NS	PSD	IM
29.2	Initiate a system project	E I-12 P-AD		R I-AD	
29.3	Conduct a detailed system investigation and analysis	E P-AD	R I-AD	R I-AD	
29.4	Design an information system	E P-AD		R I-AD	
29.5	Develop the information system	E P-AD		R I-AD	
29.6	Evaluate applications within the information system	E P-AD		R I-AD	
29.7	Develop IS implementation plan	E I-12 P-AD	R I-AD	R I-AD	
29.8	Perform management functions related to the planned change	E P-AD	E P-AD	R I-AD	
Unit 30: System Installation and Maintenance					
30.1	Explain the life cycle of an information system	E I-12 P-AD	E P-AD	R I-AD	
30.2	Implement a system	E I-12 P-AD	E P-AD	R I-AD	
30.3	Perform software configuration and installation	E P-AD	E P-AD	R I-AD	
30.4	Monitor the information system	E I-12 P-AD	E P-AD	R I-AD	
30.5	Perform system maintenance	E P-12 R-AD	E P-AD		
30.6	Manage backup and recovery, both on and offsite	E P-AD	E I-12 P-AD		
30.7	Troubleshoot problems	E P-12 R-AD	E I-12 P-AD		
30.8	Evaluate problem-solving processes and results	E P-12 R-AD	E I-12 P-AD		
30.9	Integrate software upgrades and fixes	E P-12 R-AD	E I-12 P-AD		
Unit 31: System Administration and Control					
31.1	Analyze and perform general system administration tasks	E I-12 P-AD	E P-AD	R I-AD	

Competency		ISS	NS	PSD	IM
31.2	Analyze and perform advanced system administration tasks	R I-AD			
31.3	Develop control language programs to access system functions and database files	R P-AD		R I-AD	
31.4	Integrate cross platform data exchange	R P-AD	R I-AD	R I-AD	
31.5	Store media	R P-AD		R I-AD	
Unit 32: Database Management System Basics					
32.1	Demonstrate knowledge of Database Management System (DBMS) basics	E I-12 P-AD	R I-AD	E I-12 P-AD	
32.2	Apply data structure concepts to store and retrieve data	E I-12 P-AD		R I-12 P-AD	
32.3	Design and implement stored procedures	R I-AD		R I-AD	
32.4	Create database query	E I-12 P-AD		E I-12 P-AD	
32.5	Employ a DBMS	R I-AD		R I-12 P-AD	
32.6	Manage implementation of a DBMS	R I-AD		R I-AD	
32.7	Monitor a DBMS	R I-AD	R I-AD	R I-AD	
Unit 33: Application Database Administration					
33.1	Apply databases to actual situations and business problems	R I-12 P-AD		E I-10 P-12 R-AD	
33.2	Apply data modeling techniques	R I-AD		E I-12 P-AD	
33.3	Create conceptual data models	R I-AD		R I-AD	
33.4	Validate conceptual data models	R I-AD		R I-AD	
33.5	Integrate conceptual data models with enterprise models	R I-AD		R I-AD	
33.6	Reconcile conceptual models with appropriate-level process models	R I-AD		R I-AD	
33.7	Create logical data models	R I-AD		R I-AD	

Competency		ISS	NS	PSD	IM
33.8	Identify unique identifiers	R I-12 R-AD		E I-10 R-12 P-AD	
33.9	Normalize data models	R I-AD		E I-10 R-12 P-AD	
33.10	Reconcile conceptual models with lower process models	R I-AD		R I-AD	
Unit 34: Database Administration					
34.1	Determine environment/platform for physical database structures and software	R I-AD	R I-12 R-AD	R I-AD	
34.2	Identify backup and recovery requirements for physical database	E P-AD	E P-AD	R I-AD	
34.3	Identify and integrate database access requirements	R I-AD	R I-AD	R I-10 R-12 R-AD	
34.4	Specify physical database characteristics	R I-AD		R I-12 R-AD	
34.5	Reconcile physical design with processing requirements	R I-AD		R I-AD	
Unit 35: Data Warehousing					
35.1	Demonstrate knowledge of basic data warehousing concepts	R I-AD	R I-AD	R I-AD	
35.2	Apply ethical behaviors to data warehousing		R I-AD	R I-AD	
35.3	Perform data entry and updating			R I-AD	
35.4	Perform data retrieval			R I-AD	
35.5	Apply data			R I-AD	
Unit 36: Interactive Multimedia Production					
36.1	Demonstrate knowledge of interactive media	R I-12 R-AD		R I-12 R-AD	E P-12 R-AD
36.2	Produce interactive media as a member of a development team	R I-12 R-AD		R I-AD	E P-12 R-AD
36.3	Develop project concept proposal	R I-12 R-AD		R I-AD	E P-12 R-AD

Competency		ISS	NS	PSD	IM
36.4	Develop navigational structures	R I-AD		R I-12 P-AD	E I-12 P-AD
36.5	Develop scripts, storyboards and flowcharts used in interactive media	R I-12 R-AD		R I-12 R-AD	E P-12 R-AD
36.6	Combine media elements to produce an interactive multimedia project	R I-12		R I-12	E I-12 P-AD
36.7	Explain the types and uses of interactive media applications	R I-AD		R I-12 R-AD	E P-12 R-AD
36.8	Demonstrate knowledge of developing a training product	E I-12 P-AD			E P-12 R-AD
36.9	Develop a training product	R I-AD			E I-12 P-AD
36.10	Maintain interactive media equipment	R I-AD			R P-12 R-AD
36.11	Assess interactive media career opportunities	R I-AD			E I-10 P-12 R-AD
Unit 37: Appreciation of the Arts					
37.1	Demonstrate knowledge of and an appreciation for music	R I-AD			E I-10 R-12 P-AD
37.2	Demonstrate knowledge of and an appreciation for the visual arts	R I-AD			E I-10 R-12 P-AD
37.3	Demonstrate knowledge of and an appreciation for literature	R I-AD			E I-10 P-12 R-AD
Unit 38: Graphic Design Fundamentals					
38.1	Demonstrate basic knowledge of technical art skills (traditional and electronic)	R I-AD			E P-12 R-AD
38.2	Demonstrate knowledge of design principles	R I-AD		E I-10 R-12 P-AD	E P-12 R-AD

Competency		ISS	NS	PSD	IM
38.3	Demonstrate design skills	R I-AD		R I-10 R-12 R-AD	E P-12 R-AD
38.4	Demonstrate knowledge of available graphics software applications	R I-AD		R I-12 R-AD	E P-12 R-AD
38.5	Construct digital graphics	R I-AD		R I-AD	E P-12 R-AD
38.6	Manipulate digital graphics	R I-AD		R I-12 R-AD	E P-12 R-AD
38.7	Integrate knowledge of typography	R I-AD			E P-12 R-AD
Unit 39: Photography					
39.1	Develop competency in the use of photographic equipment	R I-12			E I-12 P-AD
39.2	Demonstrate knowledge of photographic terminology	R I-AD			E I-12 P-AD
Unit 40: Visual Media Design					
40.1	Create visual design guidelines	R I-AD		R I-12 R-AD	E I-12 P-AD
40.2	Demonstrate proficiency in the use of digital imaging techniques and equipment	R I-AD		R I-12 R-AD	E I-12 P-AD
40.3	Demonstrate knowledge of the basic principles of 3-D modeling	R I-AD			E P-12 R-AD
40.4	Create 3-D models	R I-AD			R I-12 P-AD
40.5	Perform advanced 3-D image generation techniques	R I-AD			E P-12 R-AD
40.6	Utilize the basic principles of 2-D animation	R I-AD			E P-12 R-AD
40.7	Utilize the basic principles of 3-D animation	R I-AD			E I-12 P-AD
40.8	Develop animated characters	R I-AD			R I-12 P-AD

Competency		ISS	NS	PSD	IM
40.9	Create 3-D environments	R I-AD			R I-12 P-AD
40.10	Demonstrate knowledge of virtual environment	R I-AD			R I-12 P-AD
Unit 41: Video Production					
41.1	Identify technical support tasks of video production	R I-AD			E P-12 R-AD
41.2	Interpret the relationship between the creative and craft skills required for video production	R I-AD			E P-12 R-AD
41.3	Perform camera-related tasks for a video production	R I-AD			E I-12 P-AD
41.4	Perform lighting activities for a video production	R I-AD			E I-12 P-AD
41.5	Design scenery for a video production	R I-AD			E I-12 P-AD
41.6	Operate video cameras/camcorders	R I-AD			E P-12 R-AD
41.7	Perform technical support tasks for a video production	R I-AD			E I-12 P-AD
41.8	Identify video formats	R I-AD			E P-12 R-AD
41.9	Perform editing operations	R I-AD			E P-12 R-AD
41.10	Import/export digital video	R I-AD			E P-12 R-AD
Unit 42: Audio Production					
42.1	Demonstrate knowledge of audio recording and sound reinforcement	R I-AD			E P-12 R-AD
42.2	Demonstrate knowledge of audio production	R I-AD			E P-12 R-AD
42.3	Create a sound track	R I-AD			E I-12 P-AD

Competency		ISS	NS	PSD	IM
Unit 43: Web Page Design					
43.1	Demonstrate knowledge of usability and interface design	R I-AD		E I-12 P-AD	E P-12 R-AD
43.2	Demonstrate knowledge of Web programming basics	R I-12	R I-12 R-AD	E I-12 P-AD	E P-12 R-AD
43.3	Explain basic Web programming	R I-12	R I-12 R-AD	E I-12 P-AD	E I-12 P-AD
43.4	Apply knowledge of Web hosting	R I-AD	R P-AD	E I-12 P-AD	E I-12 P-AD
43.5	Create/maintain a static website	R I-AD		E I-10 P-12 R-AD	E P-12 R-AD
43.6	Demonstrate how to format page layout	R I-12		E I-10 P-12 R-AD	E P-12 R-AD
43.7	Demonstrate how to add audio and video to a Web page	R I-12	R I-AD	R I-12 R-AD	E I-12 P-AD
43.8	Demonstrate how to link documents	R I-12	R I-AD	E I-10 P-12 R-AD	E P-12 R-AD
Unit 44: Business Processes for IT Professionals					
44.1	Demonstrate knowledge of project planning methodology	E I-10 P-12 R-AD	E P-12 R-AD	E I-10 P-12 R-AD	E P-12 R-AD
44.2	Conduct requirements analysis	E I-12 P-AD	E I-12 P-AD	E I-12 P-AD	E I-12 P-AD
44.3	Demonstrate knowledge of the requirements analysis phase	E I-12 P-AD	E I-12 P-AD	E I-12 P-AD	E I-12 P-AD
44.4	Identify current technical environment	E I-12 P-AD	E I-12 P-AD	E I-12 P-AD	E I-12 P-AD
44.5	Demonstrate knowledge of design alternatives and options	E I-12 P-AD	E I-12 P-AD	E I-12 P-AD	E I-12 P-AD

Competency		ISS	NS	PSD	IM
44.6	Demonstrate knowledge of how systems and products are developed	E I-12 P-AD	E I-12 P-AD	E I-10 R-12 P-AD	E I-12 P-AD
44.7	Discuss solutions versus requirements	E I-12 P-AD	E P-12 R-AD	E I-12 P-AD	E I-12 P-AD
44.8	Explain quality assurance processes	E I-12 P-AD	E I-12 P-AD	E I-12 P-AD	E I-12 P-AD
44.9	Demonstrate knowledge of the testing environment	E I-12 P-AD	E I-12 P-AD	E I-12 P-AD	E P-12 R-AD
44.10	Describe key components of an implementation plan (e.g., communication, business continuity plan)	E I-12 P-AD	E I-12 P-AD	E I-12 P-AD	E I-12 P-AD
44.11	Explain the value a communication plan can provide to implementation	E P-12 R-AD	E P-12 R-AD	E P-12 R-AD	E P-12 R-AD
44.12	Explain the value a training plan can provide to implementation	E I-12 P-AD	E I-12 P-AD	E I-12 P-AD	E I-12 P-AD
44.13	Explain how business continuity plans (e.g., disaster recover, roll-back) interrelate with implementation plans	E P-12 R-AD	E I-12 P-AD	E I-12 P-AD	E I-12 P-AD
44.14	Demonstrate knowledge of information technology operations and maintenance	E I-12 P-AD	E I-12 P-AD	E I-12 P-AD	E I-12 P-AD
44.15	Explain the role of maintenance as part of the IT function	E I-12 P-AD	E I-12 P-AD	E I-12 P-AD	E I-12 P-AD
44.16	Define components of incidence and problem management	E I-12 P-AD	E I-12 P-AD	E I-12 P-AD	E I-12 P-AD
44.17	Identify components of change management process	E I-12 P-AD	E I-12 P-AD	E I-12 P-AD	E I-12 P-AD
Unit 45: Business Law and Legal Issues					
45.1	Define intellectual property rights covered by intellectual law	E I-10 R-12 P-AD	E P-12 R-AD	E I-10 P-12 R-AD	E P-12 R-AD
45.2	Describe the components of contracts	E I-12 P-AD	E I-12 P-AD	E I-12 P-AD	E I-12 P-AD
45.3	Identify current regulatory issues (e.g., HIPAA, Gramm-Leach-Bliley, Sarbanes-Oxley, NSA-National Security Act, Homeland Security)	E I-12 P-AD	E I-12 P-AD	E I-12 P-AD	E I-12 P-AD

Competency		ISS	NS	PSD	IM
Unit 46: Technical Writing and Documentation					
46.1	Evaluate technical writing requirements	E I-12 P-AD	E P-12 R-AD	E I-12 P-AD	E I-12 P-AD
46.2	Write technical reports	E I-12 P-AD	E P-12 R-AD	E I-12 P-AD	E I-12 P-AD
46.3	Conduct technical research	E I-12 P-AD	E P-12 R-AD	E I-12 P-AD	E I-12 P-AD
46.4	Design technical documentation	E I-12 P-AD	E P-12 R-AD	E I-10 R-12 P-AD	E I-10 P-12 R-AD
46.5	Develop technical documentation	E I-12 P-AD	E P-12 R-AD	E I-12 P-AD	E I-12 P-AD
Unit 47: Professional Practices					
47.1	Identify legal and ethical behavior	E I-12 P-AD	E P-12 R-AD	E I-10 P-12 R-AD	E I-12 P-AD
47.2	Explain professional responsibilities	E P-12 R-AD	E P-12 R-AD	E I-10 P-12 R-AD	E I-10 P-12 R-AD
47.3	Explain the role of the IT professional in maintaining customer satisfaction	E I-12 P-AD	E P-12 R-AD	E I-12 P-AD	E I-12 P-AD
47.4	Explain the importance of teams in achieving IT project goals	E I-12 P-AD	E P-12 R-AD	E I-12 P-AD	E I-12 P-AD
47.5	Explain the importance of professional behavior in the IT environment	E I-12 P-AD	E P-12 R-AD	E I-12 P-AD	E I-10 P-12 R-AD
47.6	Explain the importance of health and safety standards and concepts in the IT workplace	E I-10 R-12 P-AD	E P-12 R-AD	E I-12 P-AD	E I-10 P-12 R-AD
Unit 48: Basic Business Concepts					
48.1	Explain business ownership	E I-12 P-AD	E P-12 R-AD	E I-10 R-12 P-AD	E I-12 P-AD
48.2	Explain basic business organization and structure	E I-12 P-AD	E P-12 R-AD	E I-12 P-AD	E I-12 P-AD

Competency		ISS	NS	PSD	IM
48.3	Discuss the role of IT in meeting business strategic objectives	E I-12 P-AD	E I-12 P-AD	E I-12 P-AD	E I-12 P-AD
48.4	Explain how IT functions interface with other business functions	E I-12 P-AD	E P-12 R-AD	E I-12 P-AD	E I-12 P-AD
48.5	Determine factors affecting business risk	E I-12 P-AD	E I-12 P-AD	E I-12 P-AD	E I-12 P-AD
48.6	Explain basic accounting concepts	R I-12 P-AD	R I-12 R-AD	R I-AD	R I-12 P-AD
48.7	Demonstrate knowledge of cost-benefit analysis	E I-12 P-AD	E I-12 P-AD	E I-12 P-AD	E I-12 P-AD
48.8	Explain the vendor management process	E I-12 P-AD	E I-12 P-AD	E I-12 P-AD	E I-12 P-AD

Unit 1: Information Technology Basics

Students should have basic proficiency in the competencies outlined in this unit prior to entry into a program focusing on Information Support and Services, Network Systems, Programming and Software Development, and Interactive Media.

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS	P		
NS	P		
PSD	P		
IM	P	R	R

Competency 1.1: Demonstrate basic knowledge of information technology history

Descriptors:

- 1.1.1 Identify significant advances in the development of computer hardware and software
- 1.1.2 Identify major milestones in the development of information technology
- 1.1.3 Identify major individuals and their contributions to the information technology field
- 1.1.4 Discuss the speed with which computer technology has evolved (i.e., evolution time line)

Correlated English Language Arts Academic Content Benchmarks

- *Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing). [Reading Process B, 8-10; Reading Process B, 11-12]*
- *Communicate findings, reporting on the substance and processes orally, visually and in writing or through multimedia. (Research E, 8-10)*

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS	P		
NS	P		
PSD	P		
IM	P	R	R

Competency 1.2: Demonstrate basic knowledge of the information technology impact on society

Descriptors:

- 1.2.1 Discuss how information technology impacts people and is used in business/industry/government and other institutions
- 1.2.2 Discuss the impact of information technology on career pathways in business/industry (e.g., how computers have both eliminated and created jobs)

- 1.2.3 Describe the psychological, physical, and health risks associated with information technology (e.g., Web addiction, carpal tunnel syndrome, gaming)
- 1.2.4 Discuss possible security risks posed by the use of information technology and associated safeguards
- 1.2.5 Discuss possible effects of natural disasters on business operations
- 1.2.6 Discuss the evolution of international telecommunications standards and trends
- 1.2.7 Discuss the impact of computers on access to information and information exchange worldwide
- 1.2.8 Identify issues and trends affecting computers, information and personal privacy
- 1.2.9 Identify ethical issues that have surfaced in the information age
- 1.2.10 Explain how information technology affects the natural environment (e.g., disposal of equipment, energy use, use of natural resources)
- 1.2.11 Discuss how IT innovation has impacted society and corporate efficiency (e.g., RFID, eServices)
- 1.2.12 Discuss legislation that relates to information security (e.g., Gramm-Leach-Bliley Sarbanes-Oxley, Patriot Act, DMCA, HIPAA)

Correlated English Language Arts Academic Content Benchmarks

- *Organize information from various resources and select appropriate sources to support central ideas, concepts and themes.* (Research C, 8-10)
- *Communicate findings, reporting on the substance and process orally, visually and in writing, or through multimedia.* (Research E, 8-10; Research E, 11-12)
- *Compile, organize and evaluate information, take notes and summarize findings.* (Research B, 11-12)

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS	P		
NS	P		
PSD	P		
IM	P	R	R

Competency 1.3: Demonstrate knowledge of information technology basics

Descriptors:

- 1.3.1 Identify classifications of computing platforms
- 1.3.2 Identify the elements of the information processing cycle (i.e., input, process, output, and storage)
- 1.3.3 Identify major hardware components and their functions
- 1.3.4 Identify types of computer storage devices
- 1.3.5 Identify types of processing (e.g., batch, interactive, event-driven)
- 1.3.6 Identify major operating system fundamentals and components
- 1.3.7 Identify the role of the binary system in information technology
- 1.3.8 Explain the role of number systems and internal data representation in information technology

- 1.3.9 Access needed information using company and manufacturers' references (e.g., procedural manuals, documentation, standards, work flowcharts, Internet/Intranet resources)
- 1.3.10 Discuss the need for asset management (e.g., hardware, software licensing)
- 1.3.11 Differentiate between asset tracking and asset management

Correlated Mathematics Academic Content Benchmarks

- *Identify subsets of the real number system.* (Number B, 8-10)
- *Apply properties of operations and the real number system, and justify when they hold for a set of numbers.* (Number C, 8-10)
- *Connect physical, verbal and symbolic representations of integers, rational numbers and irrational numbers.* (Number D, 8-10)
- *Compare, order and determine equivalent forms of real numbers.* (Number E, 8-10)

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS	P		
NS	P		
PSD	P		
IM	P	R	R

Competency 1.4: Demonstrate knowledge of software associated with information technology

Descriptors:

- 1.4.1 Describe the key functions of systems software
- 1.4.2 Classify widely used software applications (e.g., word processing, database management, spreadsheet development)
- 1.4.3 Describe the range of languages used in software development
- 1.4.4 Explain relationship between data and software development (e.g., basic data structures, XML, relational databases)
- 1.4.5 Identify new and emerging classes of software
- 1.4.6 Explain intellectual property (e.g., software, images, open-source, documentation)
- 1.4.7 Explain the historical difference between packaged software and custom/in house developed software

Correlated English Language Arts Academic Content Benchmarks

- *Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing).* [Reading Process B, 8-10; Reading Process B, 11-12]

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS	P		
NS	P		
PSD	P		
IM	P	R	R

Competency 1.5: Evaluate career opportunities in information technology

Descriptors:

- 1.5.1 Identify entry-level positions
- 1.5.2 Identify possible career pathways within regions in Ohio, the United States and globally
- 1.5.3 Compare the types of positions included in Information Support and Services, Network Systems, Programming and Software Development, and Interactive Media (e.g., compensation, benefits, travel, quality of life)
- 1.5.4 Identify types of administration/management positions available and the nature of each
- 1.5.5 Research job opportunities
- 1.5.6 Compile occupational profile
- 1.5.7 Identify factors influencing employment opportunities (e.g., outsourcing, offshore)
- 1.5.8 Identify education and training requirements for selected career pathway
- 1.5.9 Design a career path for a personal career in information technology (i.e., personal goal setting)
- 1.5.10 Design a time line for a personal career advancement in the information technology field
- 1.5.11 Identify professional organizations in the area of information technology
- 1.5.12 Identify benefits derived from membership in specific professional organizations
- 1.5.13 Identify alternative resources related to career development (e.g., trade journals, user groups, newsgroups)
- 1.5.14 Discuss the occupational trends historically and in the future.

Correlated English Language Arts Academic Content Benchmarks

- *Use documented textual evidence to justify interpretations of literature or to support a research topic. (Writing Applications D, 8-10)*
- *Use style guides to produce oral and written reports that give proper credit for sources (e.g., words, ideas, images and information) and include an acceptable format for source acknowledgement. (Research D, 8-10, Research D, 11-12)*
- *Communicate findings, reporting on the substance and processes orally, visually and in writing or through multimedia. (Research E, 8-10, Research E, 11-12)*
- *Prepare writing for publication that follows an appropriate format and uses a variety of techniques to enhance the final product. (Writing Process F, 11-12)*

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS	P		
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PSD	P		
IM	P	R	R

Competency 1.6: Explore the future of information technologies

Descriptors:

- 1.6.1 Identify new technologies relevant to information technology
- 1.6.2 Discuss the future impact of information technology on business operations (i.e., productivity, global competitiveness)
- 1.6.3 Examine the importance of new technologies to future developments and to the future knowledge of worker productivity
- 1.6.4 Identify new and emerging drivers and inhibitors of information technology change

Correlated English Language Arts Academic Content Benchmarks

- *Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing). [Reading Process B, 8-10; Reading Process B, 11-12]*

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS	P		
NS	P		
PSD	P		
IM	P	R	

Competency 1.7: Create documents using word processing software

Descriptors:

- 1.7.1 Create documents and tables
- 1.7.2 Format text using basic and advanced formatting functions
- 1.7.3 Locate/replace text using search and replace functions
- 1.7.4 Create new forms, style sheets, and templates
- 1.7.5 Employ word processing utility tools (e.g., spell checker, grammar checker, and thesaurus)
- 1.7.6 Create tables, columns, outlines, footnotes and endnotes
- 1.7.7 Create and run macros
- 1.7.8 Assemble documents using merge functions (e.g., merge address files with letters and envelopes)
- 1.7.9 Print materials using print functions
- 1.7.10 Edit documents (i.e., version control)
- 1.7.11 Access needed information using word processing help screens

Correlated English Language Arts Academic Content Benchmarks

- *Prepare writing for publication that follows an appropriate format and uses a variety of techniques to enhance the final product.* (Writing Process F, 11-12)
- *Produce functional documents that report, organize and convey information and ideas accurately, foresee readers' problems or misunderstandings and that include formatting techniques that are user friendly.* (Writing Applications C, 11-12)

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS	P		
NS	P		
PSD	P		
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Competency 1.8: **Create relational databases**

Descriptors:

- 1.8.1 Create a database table
- 1.8.2 Edit fields and records
- 1.8.3 Modify the design of a database table
- 1.8.4 Sort and retrieve data
- 1.8.5 Perform single- and multiple-table queries (e.g., create, run, save)
- 1.8.6 Create calculated fields
- 1.8.7 Generate customized reports for database files
- 1.8.8 Process data using database functions (e.g., structure, format, attributes, relationships, and keys)
- 1.8.9 Locate/replace data using search and replace functions
- 1.8.10 Sort data using multiple-field sorts
- 1.8.11 Add/remove filters
- 1.8.12 Create multiple criteria expressions
- 1.8.13 Create adjoined files and subforms
- 1.8.14 Create graphs and reports
- 1.8.15 Print forms, reports, and results of queries
- 1.8.16 Identify the relationship between database components
- 1.8.17 Design a database to meet the needs of an actual situation or business problem
- 1.8.18 Evaluate database design and functionality

Correlated English Language Arts Academic Content Benchmarks

- *Apply knowledge of roots and affixes to determine the meanings of complex words and subject area vocabulary.* (Vocabulary E, 8-10)
- *Use multiple resources to enhance comprehension of vocabulary.* (Vocabulary E, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Create, interpret and use graphical displays and statistical measures to describe data; e.g., box-and-whisker plots, histograms, scatterplots, measures of center and variability.* (Data A, 8-10)
- *Evaluate different graphical representations of the same data to determine which is the most appropriate representation for an identified purpose.* (Data B, 8-10)
- *Translate information from one representation (words, table, graph or equation) to another representation of a relation or function.* (Algebra C, 8-10)
- *Formulate a problem or mathematical model in response to a specific need or situation, determine information required to solve the problem, choose method for obtaining this information, and set limits for acceptable solution.* (Math. Process A, 8-10)

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS	P		
NS	P		
PSD	P		
IM	P		

Competency 1.9: Create spreadsheets

Descriptors:

- 1.9.1 Design a spreadsheet in accordance with written and/or oral specifications
- 1.9.2 Retrieve existing spreadsheets
- 1.9.3 Format spreadsheets using basic formatting functions (e.g., page setup)
- 1.9.4 Perform calculations using simple formulas
- 1.9.5 Edit spreadsheets (i.e., delete, move, and copy within spreadsheets)
- 1.9.6 Create charts and graphs from spreadsheets
- 1.9.7 Group worksheets
- 1.9.8 Input/process data using spreadsheet functions
- 1.9.9 Improve spreadsheet display using enhancement features
- 1.9.10 Protect data using spreadsheet protection features
- 1.9.11 Run macros
- 1.9.12 Troubleshoot spreadsheet problems
- 1.9.13 Resolve function errors as needed
- 1.9.14 Apply advanced spreadsheet formulas
- 1.9.15 Create spreadsheet solutions to business problems
- 1.9.16 Make "what if—" business decisions using spreadsheets as a tool
- 1.9.17 Save and print spreadsheets
- 1.9.18 Access needed information using online help features

Correlated Mathematics Academic Content Benchmarks

- *Use algebraic representations, such as tables, graphs, expressions, functions and inequalities, to model and solve problem situations.* (Algebra D, 8-10)
- *Use recursive functions to model and solve problems; e.g., home mortgages, annuities.* (Algebra C, 11-12)

- *Create, interpret and use graphical displays and statistical measures to describe data; e.g., box-and-whisker plots, histograms, scatterplots, measures of center and variability. (Data A, 8-10)*
- *Evaluate different graphical representations of the same data to determine which is the most appropriate representation for an identified purpose. (Data B, 8-10)*
- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators. (Data A, 11-12)*
- *Apply reasoning processes and skills to construct logical verifications or counter-examples to test conjectures and to justify and defend algorithms and solutions. (Math. Process D, 8-10)*

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS	P		
NS	P		
PSD	P		
IM	P	R	R

Competency 1.10: Create presentations using presentation graphics

Descriptors:

- 1.10.1 Identify hardware items that support presentation software
- 1.10.2 Compare/contrast various presentation software packages
- 1.10.3 Create computer presentation and handouts in accordance with basic principles of graphics design and visual communication
- 1.10.4 Edit presentations
- 1.10.5 Copy from one presentation to another
- 1.10.6 Insert clip art in a slide
- 1.10.7 Create WordArt objects
- 1.10.8 Create/modify a graph on a slide
- 1.10.9 Add/delete a template to a presentation
- 1.10.10 Create graphics documents using drawing and painting software programs
- 1.10.11 Add transitions to slide shows
- 1.10.12 Run slide shows manually and automatically
- 1.10.13 Save slide show presentations

Correlated English Language Arts Academic Content Benchmarks

- *Communicate findings, reporting on the substance and processes orally, visually and in writing or through multimedia. (Research E, 8-10, Research E, 11-12)*
- *Produce functional documents that report, organize and convey information and ideas accurately, foresee readers' problems or misunderstandings and that include formatting techniques that are user friendly. (Writing Applications. C, 11-12)*
- *Give presentations using a variety of delivery methods, visual displays and technology. (Communication G, 8-10; Communication F, 11-12)*

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS	P		
NS	P		
PSD	P		
IM	P	R	R

Competency 1.11: Apply computer office tools

Descriptors:

- 1.11.1 Analyze problems requiring solutions involving the integration of computer applications
- 1.11.2 Select appropriate productivity tool for solving specific problem
- 1.11.3 Select source application and destination application
- 1.11.4 Move/copy information between integrated applications
- 1.11.5 Link objects between applications
- 1.11.6 Embed information in applications

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS	P		
NS	P		
PSD	P		
IM	P	R	R

Competency 1.12: Demonstrate knowledge of basic data communications components and trends

Descriptors:

- 1.12.1 Identify key communications procedures
- 1.12.2 Identify the hardware associated with telecommunications functions
- 1.12.3 Identify the uses of data communication equipment
- 1.12.4 Identify types of communications media
- 1.12.5 Identify data transmission codes and protocols
- 1.12.6 Distinguish between local area networks, wide-area networks, and other networks (e.g., wireless)
- 1.12.7 Identify data communication trends
- 1.12.8 Identify major current issues in data communications
- 1.12.9 Identify security issues

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS	P		
NS	P		
PSD	P		
IM	P	R	R

Competency 1.13: Evaluate and access information using electronic sources

Descriptors:

- 1.13.1 Explain how to conduct searches using electronic sources (e.g., selection of search terms)
- 1.13.2 Access information using telecommunications software
- 1.13.3 Access information using teleconferencing/video conferencing techniques
- 1.13.4 Access information using portable or virtual storage technology
- 1.13.5 List the uses of simulation/modeling as an information source
- 1.13.6 Evaluate the quality and usability of electronic information
- 1.13.7 Download information

Correlated English Language Arts Academic Content Benchmarks

- *Formulate open-ended research questions suitable for investigation and adjust questions as necessary while research is conducted. (Research A, 8-10; Research A, 11-12)*
- *Evaluate the usefulness and credibility of data and sources. (Research B, 8-10; Research C, 11-12)*
- *Organize information from various resources and select appropriate sources to support central ideas, concepts and themes. (Research C, 8-10)*

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS	P		
NS	P		
PSD	P		
IM	P		

Competency 1.14: Demonstrate proficiency with electronic mail and instant messaging

Descriptors:

- 1.14.1 Explain the basic purposes of e-mail systems
- 1.14.2 Identify basic e-mail features and options
- 1.14.3 Discuss security issues and guidelines for legal usage of e-mail
- 1.14.4 Identify contamination protection strategies for e-mail (e.g., Spam)
- 1.14.5 Identify available e-mail systems and the characteristics/features of each
- 1.14.6 Access e-mail system using login and password functions
- 1.14.7 Access e-mail messages received
- 1.14.8 Access e-mail attachments
- 1.14.9 Demonstrate e-mail etiquette

- 1.14.10 Create e-mail messages in accordance with established business standards (e.g., grammar, word usage, spelling, sentence structure, clarity, e-mail etiquette)
- 1.14.11 Send e-mail messages
- 1.14.12 Assign priority levels to messages
- 1.14.13 Create distribution lists
- 1.14.14 Employ e-mail options such as "reply requested" and "out-of-office reply"
- 1.14.15 Reply to and forward e-mail messages
- 1.14.16 Attach documents to messages
- 1.14.17 Create folders for organizing messages and documents
- 1.14.18 Save, print and delete e-mail messages/attachments
- 1.14.19 Access needed information using e-mail help facilities and tools
- 1.14.20 Discuss governance and acceptable use policy regarding email

Correlated English Language Arts Academic Content Benchmarks

- *Produce letters (e.g., business, letters to the editor, job applications) that follow the conventional style appropriate to the text, include appropriate details and exclude extraneous details and inconsistencies. (Writing Applications C, 8-10)*
- *Produce functional documents that report, organize and convey information and ideas accurately foresee readers’ problems or misunderstandings and that include formatting techniques that are user friendly. (Writing Applications C, 11-12)*
- *Edit to improve sentence fluency, grammar and usage. (Writing Process D, 8-10)*

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS	P		
NS	P		
PSD	P		
IM	P		

Competency 1.15: Install/configure software programs

Descriptors:

- 1.15.1 Identify hardware requirements (e.g., processor, memory, disk space, communications, printers, monitors)
- 1.15.2 Determine compatibility of hardware and software
- 1.15.3 Install given application/system software on various platforms in accordance with manufacturer's and business procedures
- 1.15.4 Access manufacturers' technical support resources.
- 1.15.5 Disable/uninstall software that may interfere with installation of new software
- 1.15.6 Verify compliance to licensing agreement
- 1.15.7 Differentiate between procedures for an upgrade and for a new installation
- 1.15.8 Differentiate between stand-alone and network installation procedures
- 1.15.9 Select appropriate installation options (e.g., default, customized)
- 1.15.10 Configure software to appropriate operating system settings
- 1.15.11 Troubleshoot unexpected results
- 1.15.12 Document step-by-step installation and configuration procedures

- 1.15.13 Verify software installation and operation
- 1.15.14 Convert data files if required
- 1.15.15 Configure macros, tools, and packages to accomplish simple organizational and personal tasks
- 1.15.16 Demonstrate backup, recovery, and restoration techniques

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS	P		
NS	P		
PSD	P		
IM	P	R	R

Competency 1.16: Demonstrate basic knowledge of the Internet

Descriptors:

- 1.16.1 Identify the key characteristics of the Internet
- 1.16.2 Discuss the ownership/administration of the Internet
- 1.16.3 Trace the development of Internet technology
- 1.16.4 Identify current issues related to the Internet
- 1.16.5 Identify services and tools offered on the Internet
- 1.16.6 Identify the specific strengths, weaknesses, and special features of available search engines
- 1.16.7 Explain bookmarks and their functions
- 1.16.8 Explain accepted Internet etiquette (i.e., netiquette)
- 1.16.9 Identify current uses and applications of the Internet

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS	P		
NS	P		
PSD	P		
IM	P	R	R

Competency 1.17: Access the Internet

Descriptors:

- 1.17.1 Connect to the Internet
- 1.17.2 Test Internet connection
- 1.17.3 Identify the components of Internet software
- 1.17.4 Install Internet software
- 1.17.5 Explore browser features
- 1.17.6 Download software upgrades from the Internet
- 1.17.7 Unpack files using compression software
- 1.17.8 Demonstrate acute awareness of virus protection techniques
- 1.17.9 Install/update firewalls and malware protection
- 1.17.10 List uses of mobile devices to access the Internet

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS	P		
NS	P		
PSD	P		
IM	P	R	R

Competency 1.18: Utilize Internet services

Descriptors:

- 1.18.1 Access business and technical information using the Internet
- 1.18.2 Select search engine(s) to use
- 1.18.3 Select appropriate search procedures and approaches
- 1.18.4 Locate information using search engine(s) and Boolean logic
- 1.18.5 Navigate Web sites using software functions (e.g., forward, back, go to, bookmarks)
- 1.18.6 Evaluate Internet resources (e.g., accuracy of information)
- 1.18.7 Access library catalogs on the Internet
- 1.18.8 Access commercial, government, and education resources
- 1.18.9 Bookmark Web addresses (URLs)
- 1.18.10 Download files from FTP archives
- 1.18.11 Communicate via e-mail using the Internet
- 1.18.12 Subscribe to mailing lists
- 1.18.13 Recognize the value of special interest groups and forums (e.g., blogs)
- 1.18.14 Retrieve online tools
- 1.18.15 Download/convert Internet programming files
- 1.18.16 Install/configure Web browser
- 1.18.17 Explore the multimedia capabilities of the World Wide Web
- 1.18.18 Evaluate plug-ins and helpers to the Web browser
- 1.18.19 Explore collaboration tools
- 1.18.20 Participate in online audio and video conferencing
- 1.18.21 Archive files
- 1.18.22 Compile a collection of business sites (e.g., finance and investment)
- 1.18.23 Explore electronic commerce

Correlated English Language Arts Academic Content Benchmarks

- *Evaluate the usefulness and credibility of data and sources.* (Research B, 8-10)
- *Evaluate the usefulness and credibility of data and sources, and synthesize information from multiple sources.* (Research C, 11-12)
- *Produce functional documents that report, organize and convey information and ideas accurately, foresee readers' problems or misunderstandings and include formatting techniques that are user friendly.* (Writing Applications C, 11-12)

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS	P		
NS	P		
PSD	P		
IM	P	R	R

Competency 1.19: Demonstrate knowledge of Web page basics

Descriptors:

- 1.19.1 Differentiate between a client and a server
- 1.19.2 Explain the role of browsers in reading files on the World Wide Web (e.g., text-only, hypertext)
- 1.19.3 Identify how different browsers affect the look of a Web page
- 1.19.4 Compare/contrast the features and functions of software editors available for designing Web pages
- 1.19.5 Explain how bandwidth affects data transmission and on-screen image
- 1.19.6 Discuss the characteristics and uses of plug-ins
- 1.19.7 Compare the advantages and disadvantages of running one's own server vs. using a server provider

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS	P		
NS	P		
PSD	P		
IM	P		

Competency 1.20: Install computer system (e.g., monitor, keyboard, disk drive, and printer)

Descriptors:

- 1.20.1 Identify primary PC components and the functions of each
- 1.20.2 Discuss how hardware components interact and how conflicts arise
- 1.20.3 Access needed information using manufacturers' references (e.g., procedural manuals, documentation, standards, work flowcharts)
- 1.20.4 Secure supplies and resources
- 1.20.5 Respond to error messages and symptoms of hardware failure
- 1.20.6 Install boards to support peripherals
- 1.20.7 Connect peripherals to CPU
- 1.20.8 Employ appropriate safety precautions when working with PCs
- 1.20.9 Configure system
- 1.20.10 Verify system operation
- 1.20.11 Document system installation activities
- 1.20.12 Backup system configuration
- 1.20.13 Test all applications

Unit 2: Operating Systems

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS	I	R	P
NS		P	R
PSD		I	P
IM		I	P

Competency 2.1: Explain operating systems

Descriptors:

- 2.1.1 Compare and contrast operating systems (ISS, PSD, IM)
- 2.1.2 Differentiate between microcomputer, minicomputer, and mainframe operating systems including handheld devices (e.g., tablets, PDA, pocket PC) [ISS, IM]
- 2.1.3 Define the role of memory management in an operating system (ISS, PSD)
- 2.1.4 Describe the system utilities used for file management
- 2.1.5 Analyze operating system interfaces
- 2.1.6 Differentiate the features among file systems (e.g., NTFS, FAT32) [ISS]

Correlated English Language Arts Academic Content Benchmarks

- *Apply knowledge of roots, affixes and phrases to aid understanding of content area vocabulary.* (Vocabulary D, 11-12)
- *Use multiple resources to enhance comprehension of vocabulary.* (Vocabulary F, 8-10) [Vocabulary E, 11-12]

BIL: **Essential:** **ISS, PSD, IM**
Recommended: NS

EDU:	10	12	AD
ISS		I	P
NS		I	P
PSD		I	P
IM		I	P

Competency 2.2: Describe computer memory utilization

Descriptors:

- 2.2.1 Differentiate among memory types for PCs, mainframes, minicomputers, and networks (ISS, PSD, IM)
- 2.2.2 Differentiate among the functions of extended memory, expanded memory, and cache memory (ISS, IM)
- 2.2.3 Describe the role of the relationship between memory and software applications (ISS, PSD, IM)

- 2.2.4 Describe memory management functions (e.g., contiguous allocation, paging, segmentation, virtual memory)
- 2.2.5 Describe the role of physical memory and registers
- 2.2.6 Describe the role of overlays, swapping, and partitions
- 2.2.7 Describe the role of pages and segments
- 2.2.8 Describe the role of free lists, layout, servers, interrupts and recovery from failures

Correlated English Language Arts Academic Content Benchmarks

- *Use multiple resources to enhance comprehension of vocabulary.* (Vocabulary E, 11-12)

BIL: **Essential:** **ISS, NS, PSD**

EDU:	10	12	AD
ISS		I	P
NS		I	P
PSD		I	P
IM			

Competency 2.3: Implement and maintain security compliance

Descriptors:

- 2.3.1 Implement security procedures in accordance with government standards, and business ethics (NS, ISS)
- 2.3.2 Ensure compliance with security rules, regulations, and codes (NS, ISS)
- 2.3.3 Analyze security risks (e.g., networking, software) [ISS]
- 2.3.4 Assess exposure to security issues (NS, ISS)
- 2.3.5 Implement countermeasures
- 2.3.6 Install and update virus detection and protection software (NS, PSD, ISS)
- 2.3.7 Identify sources of virus infections and remove viruses (NS, PSD, ISS)
- 2.3.8 Implement backup and disaster recovery procedures (NS, PSD, ISS)
- 2.3.9 Follow disaster plan (NS, ISS)
- 2.3.10 Provide for user authentication (e.g., assign passwords, access level) [NS, PSD, ISS]
- 2.3.11 Document security procedures (NS, ISS)

BIL: **Essential:** **ISS, NS**

EDU:	10	12	AD
ISS		I	P
NS		I	P
PSD			
IM			

Competency 2.4: Apply systems operations procedures

Descriptors:

- 2.4.1 Apply basic commands of operating system software (ISS, NS)
- 2.4.2 Apply appropriate file and disk management techniques (NS)
- 2.4.3 Access needed information using appropriate reference materials (NS)

- 2.4.4 Review automated scheduling software (NS)
- 2.4.5 Follow power-up and logon procedures (ISS, NS)
- 2.4.6 Interact with/respond to system messages using console device (NS)
- 2.4.7 Run applications/jobs in accordance with processing procedures (NS)
- 2.4.8 Identify scheduling priority in programming (NS)
- 2.4.9 Utilize audit trails (NS)
- 2.4.10 Initiate system software command structures using operating system macro facilities for computer systems
- 2.4.11 Follow logoff and power-down procedure(s) [ISS, NS]

BIL: **Essential:** **ISS, NS**
Recommended: **PSD**

EDU:	10	12	AD
ISS		I	P
NS		I	P
PSD		I	R
IM			

Competency 2.5: Maintain and respond to system needs

Descriptors:

- 2.5.1 Access needed information using appropriate reference materials (ISS, NS)
- 2.5.2 Monitor system status and performance (NS)
- 2.5.3 Run diagnostics and respond to system messages (NS)
- 2.5.4 Document computer system malfunction(s) and software malfunction(s) [NS]
- 2.5.5 Install and upgrade software packages (ISS, NS)
- 2.5.6 Restore system (NS)
- 2.5.7 Review automated scheduling software (NS)
- 2.5.8 Create a query to extract information from a file or multiple files and create reports (NS)

Correlated English Language Arts Academic Content Benchmarks

- *Produce functional documents that report, organize and convey information and ideas accurately foresee readers' problems or misunderstandings and that include formatting techniques that are user friendly.* (Writing Applications C, 11-12)

BIL: **Essential:** **ISS, IM**
Recommended: **NS, PSD**

EDU:	10	12	AD
ISS		P	R
NS		I	P
PSD		I	R
IM		I	P

Competency 2.6: Perform standard computer backup procedures

Descriptors:

- 2.6.1 Recognize the need for regular backup procedures (IM)
- 2.6.2 Plan a backup process (IM)
- 2.6.3 Install backup software (IM)
- 2.6.4 Perform restore operation using backup software (IM)
- 2.6.5 Run compression drive backup software and restore operation using compression drive backup software (IM)
- 2.6.6 Identify and maintain uninterruptible battery backup equipment (IM)
- 2.6.7 Install surge suppression protection (IM)
- 2.6.8 Compare/contrast full, incremental and differential backups

Unit 3: Software Systems Management

BIL: **Essential:** **ISS, NS, PSD**

EDU:	10	12	AD
ISS		I	P
NS			P
PSD		I	P
IM			

Competency 3.1: Perform configuration management activities

Descriptors:

- 3.1.1 Describe identification and control functions (ISS, PSD)
- 3.1.2 Explain version management and interface control (ISS, PSD)
- 3.1.3 Select appropriate tools for configuration management
- 3.1.4 Determine standards to be applied (e.g., international, industry, military)
- 3.1.5 Specify baseline and software life-cycle phases (PSD)
- 3.1.6 Assess the impact of changes that affect interfaces (PSD)

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS		I	P
NS			P
PSD		I	P
IM		I	P

Competency 3.2: Evaluate application software packages

Descriptors:

- 3.2.1 Perform work flow analysis to determine user needs (PSD)
- 3.2.2 Compare/contrast ease of learning, use, and interfacing for different software packages (ISS, IM)
- 3.2.3 Compare/contrast performance and features of different software packages (e.g., speed of retrieval, copying, saving, speller, thesaurus, moving, sorting) [ISS, PSD, IM]
- 3.2.4 Compare/contrast ease of technical support for different software packages
- 3.2.5 Compare/contrast clarity of documentation for different software packages
- 3.2.6 Compare/contrast licensing agreements for different software packages
- 3.2.7 Document results of the software evaluation (ISS, PSD)
- 3.2.8 Perform a software audit for the purpose of asset management
- 3.2.9 Perform a physical audit for the purpose of asset management
- 3.2.10 Evaluate appropriateness of software for specific projects (ISS, IM)
- 3.2.11 Prepare a cost-benefit analysis for a software package
- 3.2.12 Develop a method for evaluation
- 3.2.13 Test the functionality of proposed software configuration (IM)

Correlated English Language Arts Academic Content Benchmarks

- *Analyze the features and structures of documents and critique them for their effectiveness.* (Reading: Informational Text A, 11-12)
- *Produce functional documents that report, organize and convey information and ideas accurately, foresee readers' problems or misunderstandings and include formatting techniques that are user friendly.* (Writing Applications C, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Evaluate the validity of claims and predictions that are based on data by examining the appropriateness of the data collection and analysis.* (Data E, 8-10)
- *Model and solve problems situations involving direct and inverse variation.* (Algebra I, 8-10)
- *Locate and interpret mathematical information accurately, and communicate ideas, processes and solutions in a complete and easily understood manner.* (Math. Process H, 8-10)
- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators.* (Data A, 11-12)
- *Construct algorithms for multi-step and non-routine problems.* (Math. Process A, 11-12)
- *Apply mathematical modeling to workplace and consumer situations, including problem formulation, identification of a mathematical model, interpretations of solution within the model, and validations to original problem situation.* (Math. Process J, 11-12)

Unit 4: Computer User Support

BIL: **Essential:** **ISS, NS**
Recommended: **PSD**

EDU:	10	12	AD
ISS		I	P
NS		I	P
PSD			I
IM			

Competency 4.1: Analyze technical support needed

Descriptors:

- 4.1.1 Identify support requirements (ISS, NS)
- 4.1.2 Apply information and data analysis techniques using problem solving and critical thinking skills (NS)
- 4.1.3 Identify support risks (i.e., security, downtime) [NS]
- 4.1.4 Examine present data and system configuration (NS)
- 4.1.5 Formulate a support plan including service-level agreements
- 4.1.6 Utilize technical assistance resources (e.g., knowledge-bases, remote control services, TAC centers, Web-based tools, and built-in help functions) [ISS, NS]

Correlated English Language Arts Academic Content Benchmarks

- *Produce functional documents that report, organize and convey information and ideas accurately, foresee readers' problems or misunderstandings and include formatting techniques that are user friendly. (Writing Applications C, 11-12)*

BIL: **Essential:** **ISS, NS**

EDU:	10	12	AD
ISS		I	P
NS		I	P
PSD			
IM			

Competency 4.2: Perform customer service

Descriptors:

- 4.2.1 Provide technical support (ISS)
- 4.2.2 Respond to user questions (ISS, NS)
- 4.2.3 Provide troubleshooting for hardware/software (ISS, NS)
- 4.2.4 Communicate and document technical support provided (ISS, NS)
- 4.2.5 Optimize system performance (NS)
- 4.2.6 Diagnose problems within system (ISS, NS)

- 4.2.7 Perform technical functions required by customer/user within the knowledge set of the technician (NS)
- 4.2.8 Employ technical and computer tools to perform task in the most cost-effective manner (NS)
- 4.2.9 Meet customer expectation in service delivery (e.g., SLA) [NS]
- 4.2.10 Demonstrate effective customer satisfaction skills throughout the service event life cycle (NS)

Correlated English Language Arts Academic Content Benchmarks

- *Use a variety of strategies to enhance listening comprehension.* (Communication A, 8-10; Communication A, 11-12)
- *Select and use effective speaking strategies for a variety of audiences, situations and purposes.* (Communication C, 11-12)
- *Give informational presentations that contain a clear perspective, present ideas from multiple sources in logical sequence and include a consistent organizational structure.* (Communication E, 11-12)

BIL: **Essential:** **ISS, NS**
Recommended: **PSD**

EDU:	10	12	AD
ISS		I	P
NS		I	P
PSD			I
IM			

Competency 4.3: Provide support and training

Descriptors:

- 4.3.1 Operate help desk
- 4.3.2 Support computer users (ISS) [NS]
- 4.3.3 Train computer users (NS)
- 4.3.4 Manage user accounts (NS)
- 4.3.5 Update and maintain training and users manuals (soft or hard copies) [NS]
- 4.3.6 Demonstrate ability to guide end-users through a support solution process (NS)

Correlated English Language Arts Academic Content Benchmarks

- *Use multiple resources to enhance comprehension of vocabulary.* (Vocabulary F, 8-10; Vocabulary E, 11-12)
- *Produce functional documents that report, organize and convey information and ideas accurately, foresee readers’ problems or misunderstandings and include formatting techniques that are user friendly.* (Writing Applications C, 11-12)

Unit 5: Programming Theory

BIL: **Essential:** **PSD**
Recommended: **ISS, IM**

EDU:	10	12	AD
ISS		I	R
NS			
PSD	I	P	R
IM		I	P

Competency 5.1: Demonstrate knowledge of programming language concepts

Descriptors:

- 5.1.1 Describe the concept of problem solving through programming languages
- 5.1.2 Describe the concepts of data management through programming languages
- 5.1.3 Analyze the strength and weaknesses of a language to solve a specific problem
- 5.1.4 Describe the function and operation of compilers and interpreters
- 5.1.5 Describe the basics of procedural/structured, object-oriented, and event-driven programming

Correlated English Language Arts Academic Content Benchmarks

- *Compile, organize and evaluate information, take notes and summarize findings.* (Research B, 11-12)
- *Evaluate the usefulness and credibility of data and sources and synthesize information from multiple sources.* (Research C, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Formulate a problem or mathematical model in response to a specific need or situation, determine information required to solve the problem, choose method for obtaining this information, and set limits for acceptable solution.* (Math. Process A, 8-10)

BIL: **Essential:** **PSD**
Recommended: **ISS, IM**

EDU:	10	12	AD
ISS		I	R
NS			
PSD		I	P
IM		I	P

Competency 5.2: Apply software design techniques

Descriptors:

- 5.2.1 Provide an overview of problem to be solved (PSD)

- 5.2.2 Establish basic input and output structures and business rules (PSD)
- 5.2.3 Model solution using both graphical tools (e.g., UML, flowchart) and pseudocode techniques

Correlated Mathematics Academic Content Benchmarks

- *Translate information from one representation (words, table, graph or equation) to another representation of a relation or function. (Algebra C, 8-10)*

BIL: **Essential:** **PSD**
Recommended: **ISS, IM**

EDU:	10	12	AD
ISS		I	R
NS			
PSD	I	P	R
IM		I	P

Competency 5.3: Identify models of application

Descriptors:

- 5.3.1 Identify structured/modular programming
- 5.3.2 Identify the characteristics and uses of batch processing
- 5.3.3 Identify the characteristics and uses of interactive processing
- 5.3.4 Identify the characteristics and uses of event-driven processing
- 5.3.5 Identify the characteristics and uses object-oriented processing

Correlated English Language Arts Academic Content Benchmarks

- *Distinguish the relationship of word meanings between pairs of words encountered in analogical statements. (Vocabulary B, 11-12)*

Unit 6: Applied Programming Languages

Each competency must be addressed in at least two of the following language types:

- Structural/Procedural (e.g., Basic, C, Visual Basic, RPG, COBOL)
- Object-Oriented (e.g., Java, C++ .NET Framework)
- Scripting/Control (e.g., JCL, Perl)
- Data Description (e.g., IOL, SQL)
- Machine Level (e.g., Assembly)
- Mark-up (e.g., HTML, SML, SGML)

BIL: **Essential:** **PSD**
Recommended: **ISS**

EDU:	10	12	AD
ISS		I	R
NS			
PSD	I	P	R
IM			

Competency 6.1: Demonstrate knowledge of computational and String operations

Descriptors:

- 6.1.1 Develop code blocks that use arithmetic operations
- 6.1.2 Develop programs that use subtotals and final totals
- 6.1.3 Develop code blocks applying string operations (concatenation, pattern matching, substring, etc.)

Correlated Mathematics Academic Content Benchmarks

- *Apply properties of operations and the real number system, and justify when they hold for a set of numbers. (Number C, 8-10)*
- *Use recursive functions to model and solve problems; e.g., home mortgages, annuities. (Algebra C, 11-12)*
- *Evaluate a mathematical argument and use reasoning and logic to judge its validity. (Math. Process E, 11-12)*

BIL: **Essential:** **PSD**
Recommended: **ISS**

EDU:	10	12	AD
ISS		I	R
NS			
PSD	I	P	R
IM			

Competency 6.2: Demonstrate knowledge of logical operations and control structures

Descriptors:

- 6.2.1 Solve a truth table
- 6.2.2 Explain the concepts of the if/then/else control structure

- 6.2.3 Develop code blocks that use relational operators and compounds
- 6.2.4 Develop code blocks using sequential control structures
- 6.2.5 Develop code blocks using repetition control structures (e.g., while, for)
- 6.2.6 Develop code blocks using selection control structures (e.g., case, switch)

BIL: **Essential:** **PSD**
Recommended: **ISS**

EDU:	10	12	AD
ISS		I	R
NS			
PSD	I	P	R
IM			

Competency 6.3: Use integrated development environment to build a program

Descriptors:

- 6.3.1 Configure preferences and options within a development environment
- 6.3.2 Use editors
- 6.3.3 Utilize design tool from the integrated development environment (IDE) and third party
- 6.3.4 Compile or interpret program into runnable form
- 6.3.5 Run program
- 6.3.6 Use tools contained within an IDE

BIL: **Essential:** **PSD**
Recommended: **ISS**

EDU:	10	12	AD
ISS		I	R
NS			
PSD	I	P	R
IM			

Competency 6.4: Debug programs

Descriptors:

- 6.4.1 Test/run program
- 6.4.2 Correct syntax errors
- 6.4.3 Correct run-time errors
- 6.4.4 Debug logic errors

Correlated Mathematics Academic Content Benchmarks

- *Construct algorithms for multi-step and non-routine problems. (Math. Process A, 11-12)*

BIL: **Recommended: ISS, PSD**

EDU:	10	12	AD
ISS		I	R
NS			
PSD	I	P	
IM			

Competency 6.5 Develop programs by applying specialized techniques and tools

Descriptors:

- 6.5.1 Develop programs using data-validation techniques
- 6.5.2 Develop programs using reuse libraries
- 6.5.3 Develop programs using operating system calls

Unit 7: Software Development Overview

BIL: **Essential:** **PSD**
Recommended: **ISS**

EDU:	10	12	AD
ISS			I
NS			
PSD		I	P
IM			

Competency 7.1: Demonstrate knowledge of software development methodology

Descriptors:

- 7.1.1 Compare various system development life cycles (e.g., waterfall, RUP, iterative) [PSD]
- 7.1.2 Apply the principles of program design (e.g., structured, object-oriented, event-driven) [PSD]
- 7.1.3 Describe how to resolve program implementation issues (e.g., debugging, documentation, auditing, revision control)
- 7.1.4 Describe the need for requirements specification documentation
- 7.1.5 Explain the implication of nonfunctional requirements (e.g., security, integrity, response time, and reliability) on solution design

Correlated English Language Arts Academic Content Benchmarks

- *Use multiple resources to enhance comprehension of vocabulary.* (Vocabulary E, 11-12)

BIL: **Essential:** **PSD**
Recommended: **ISS**

EDU:	10	12	AD
ISS			I
NS			
PSD		I	P
IM			

Competency 7.2: Demonstrate knowledge of basic software systems design

Descriptors:

- 7.2.1 Access needed information using company and manufacturers' references (e.g., procedural manuals, documentation, standards, work flowcharts)
- 7.2.2 Analyze documentation, forms, notes, and source data (PSD)
- 7.2.3 Identify constraints
- 7.2.4 Identify system processing requirements
- 7.2.5 Identify input and output (I/O) requirements (PSD)
- 7.2.6 Design system inputs, outputs, and processes
- 7.2.7 Prepare logic using program flowchart

7.2.8	Define variables (PSD)
7.2.9	Select programming language
7.2.10	Create design documentation (PSD)
7.2.11	Design implementation plan
7.2.12	Design project plan
7.2.13	Prepare dataflow diagram (PSD)
7.2.14	Present system design to management
7.2.15	Present system design to users
7.2.16	Select computer-aided software engineering (CASE) tools
7.2.17	Review design (e.g., peer and/or user walkthrough) [PSD]

Correlated English Language Arts Academic Content Benchmarks

- *Give informational presentations that present ideas in a logical sequence, include relevant facts and details from multiple sources and use a consistent organizational structure.* (Communication E, 8-10)
- *Select and use effective speaking strategies for a variety of audiences, situations and purposes.* (Communication C, 11-12)
- *Give presentations using a variety of delivery methods, visual displays and technology.* (Communication G, 8-10; Communication F, 11-12)
- *Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing).* (Reading Process B, 8-10; Reading Process B, 11-12)
- *Produce functional documents that report, organize and convey information and ideas accurately, foresee readers' problems or misunderstandings and include formatting techniques that are user friendly.* (Writing Applications C, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Identify subsets of the real number system.* (Number B, 8-10)
- *Apply properties of operations and the real number system, and justify when they hold for a set of numbers.* (Number C, 8-10)
- *Connect physical, verbal and symbolic representations of integers, rational numbers and irrational numbers.* (Number D, 8-10)
- *Translate information from one representation (words, table, graph or equation) to another representation of a relation or function.* (Algebra C, 8-10)
- *Use algebraic representations, such as tables, graphs, expressions, functions and inequalities, to model and solve problem situations.* (Algebra D, 8-10)

BIL: **Essential:** **ISS, PSD**

EDU:	10	12	AD
ISS			P
NS			
PSD		I	P
IM			

Competency 7.3: Develop software requirements/specifications

Descriptors:

- 7.3.1 Identify the business/organizational problem/objective (PSD)
- 7.3.2 Access needed information using company references (e.g., procedural manuals, documentation, standards, work flowcharts)
- 7.3.3 Analyze requirements/specifications using current approaches (e.g., structured analysis, object-oriented analysis, prototyping, Jackson System Development)
- 7.3.4 Clarify specifications using questioning techniques
- 7.3.5 Follow specifications or drawings (PSD)
- 7.3.6 Record business process (e.g., using flowchart, step-by-step narrative, case analysis)
- 7.3.7 Record data (PSD)
- 7.3.8 Gather information using interviewing strategies
- 7.3.9 Develop informal specifications (PSD)
- 7.3.10 Develop formal specifications
- 7.3.11 Identify documentation needs
- 7.3.12 Identify computing standards and methodologies
- 7.3.13 Identify security measures
- 7.3.14 Present software requirements to users

Correlated English Language Arts Academic Content Benchmarks

- *Utilize multiple sources pertaining to a singular topic to critique the various ways authors develop their ideas (e.g., treatment, scope and organization). (Reading: Informational Text E, 8-10)*
- *Synthesize the content from several sources on a single issue or written by a single author, clarifying ideas and connecting them to other sources and related topics. (Reading: Informational Text D, 11-12)*
- *Produce functional documents that report, organize and convey information and ideas accurately, foresee readers’ problems or misunderstandings and include formatting techniques that are user friendly (Writing Applications C, 11-12)*
- *Use revision strategies to improve the style, variety of sentence structure, clarity of controlling idea, logic, effectiveness of word choice and transitions between paragraphs, passages or ideas. (Writing Process C, 8-10)*
- *Use a variety of strategies to revise content, organization and style, and to improve word choice, sentence variety, clarity and consistency of writing. (Writing Process C, 11-12)*
- *Select and use effective speaking strategies for a variety of audiences, situations and purposes. (Communication C, 11-12)*

- Give informational presentations that contain a clear perspective, present ideas from multiple sources in logical sequence and include a consistent organizational structure. (Communication E, 11-12)

Correlated Mathematics Academic Content Benchmarks

- Formulate a problem or mathematical model in response to a specific need or situation, determine information required to solve the problem, choose method for obtaining this information, and set limits for acceptable solution. (Math. Process A, 8-10)

BIL: **Essential:** **PSD**

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Competency 7.4: Code programs

Descriptors:

- 7.4.1 Access needed information using company and manufacturers' references (e.g., procedural manuals, documentation, standards, work flowcharts)
- 7.4.2 Prepare detailed flowchart for coding program (PSD)
- 7.4.3 Generate source code using programming tools in accordance with established standards
- 7.4.4 Code and integrate security measures into source code
- 7.4.5 Code error-handling techniques
- 7.4.6 Interface program with data repository
- 7.4.7 Design reports in accordance with system design and user specifications
- 7.4.8 Write code to instantiate and print report objects upon user request
- 7.4.9 Generate executable code
- 7.4.10 Debug compilation errors (PSD)
- 7.4.11 Review code with peers or design team (PSD)
- 7.4.12 Report progress based on time line (PSD)

Correlated Mathematics Academic Content Benchmarks

- Use algebraic representations, such as tables, graphs, expressions, functions and inequalities, to model and solve problem situations. (Algebra D, 8-10)
- Construct algorithms for multi-step and non-routine problems. (Math. Process A, 11-12)
- Apply mathematical modeling to workplace and consumer situations, including problem formulation, identification of a mathematical model, interpretation of solution within the model, and validation to original problem situation. (Math. Process J, 11-12)

BIL: **Essential:** **PSD**
Recommended: **ISS**

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Competency 7.5: Execute software testing, validation, change control, defect tracking, and documentation

Descriptors:

- 7.5.1 Access needed information
- 7.5.2 Develop comprehensive test plan
- 7.5.3 Develop test system
- 7.5.4 Develop test procedures
- 7.5.5 Perform tests (PSD)
- 7.5.6 Document errors (PSD)
- 7.5.7 Perform regression tests
- 7.5.8 Update design documentation
- 7.5.9 Prepare program documentation (PSD)
- 7.5.10 Prepare user documentation
- 7.5.11 Perform user acceptance test
- 7.5.12 Validate user documentation
- 7.5.13 Review results with customer/user
- 7.5.14 Report progress based on time line (PSD)

Correlated English Language Arts Academic Content Benchmarks

- *Select and use an appropriate organizational structure to refine and develop ideas for writing.* (Writing Process B, 11-12)
- *Use revision strategies to improve the style, variety of sentence structure, clarity of controlling idea, logic, effectiveness of word choice and transitions between paragraphs, passages or ideas.* (Writing Process C, 8-10)
- *Use a variety of strategies to revise content, organization and style, and to improve word choice, sentence variety, clarity and consistency of writing.* (Writing Process C, 11-12)
- *Apply editing strategies to eliminate slang and improve conventions.* (Writing Process D, 11-12)
- *Produce functional documents that report, organize and convey information and ideas accurately, foresee readers’ problems or misunderstandings and include formatting techniques that are user friendly.* (Writing Applications C, 11-12)
- *Produce informational essays or reports that establish a clear and distinctive perspective on the subject, include relevant perspectives, take into account the validity and reliability of sources and provide a clear sense of closure.* (Writing Applications D, 11-12)

- Give informational presentations that present ideas in a logical sequence, include relevant facts and details from multiple sources and use a consistent organizational structure. (Communication E, 8-10)
- Select and use effective speaking strategies for a variety of audiences, situations and purposes. (Communication C, 11-12)

BIL: **Essential:** **PSD**

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Competency 7.6: Demonstrate knowledge of data structures

Descriptors:

- 7.6.1 Explain techniques for data abstraction
- 7.6.2 Discuss program design using abstraction
- 7.6.3 Explain data structures (e.g., arrays and records, lists, trees, hashing, priority queues and heaps, equivalence relations, and graphs) as they apply to simulation (PSD)
- 7.6.4 Analyze mathematically the efficiency of algorithms that manipulate and use data structures in searching, sorting, dictionary operations, and graphing
- 7.6.5 Estimate algorithm efficiency using data structure concepts

Correlated Mathematics Academic Content Benchmarks

- Create, interpret and use graphical displays and statistical measures to describe data; e.g., box-and-whisker plots, histograms, scatterplots, measure of center and variability. (Data A, 8-10)
- Connect statistical techniques to applications in workplace and consumer situations. (Data D, 11-12)

Unit 8: Application Development Life Cycle

This unit is based upon the integration of multiple programs, components, and data tables into an application or system. Related competencies may be found in “Software Development” which focuses on the development of a single program application.

BIL: **Essential:** **ISS, PSD**

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Competency 8.1: Conduct requirements analysis

Descriptors:

- 8.1.1 Determine development methodology (e.g., waterfall, XP, RUP)
- 8.1.2 Define business problem to be solved by the application (e.g., through interview process) [PSD]
- 8.1.3 Access needed information using company procedural manuals, references, documentation, and standards (PSD)
- 8.1.4 Define business information requirements (PSD)
- 8.1.5 Determine computer hardware and software needs (PSD)
- 8.1.6 Interpret source data, charts, and graphs
- 8.1.7 Review organizational structure
- 8.1.8 Interpret existing operating documents and procedures for the system
- 8.1.9 Observe existing procedures
- 8.1.10 Document existing procedures
- 8.1.11 Document possible alternative solutions
- 8.1.12 Identify processing requirements
- 8.1.13 Define high-level specifications (PSD)
- 8.1.14 Complete a requirements analysis document
- 8.1.15 Present findings and recommendations to users and management (e.g., confirm cost-benefit analysis, risk assessment, high-level work plan, project estimate)

Correlated English Language Arts Academic Content Benchmarks

- *Analyze the features and structures of documents and critique them for their effectiveness.* (Reading: Informational Text A, 11-12)
- *Produce functional documents that report, organize and convey information and ideas accurately, foresee readers’ problems or misunderstandings and include formatting techniques that are user friendly.* (Writing Applications C, 11-12)

- *Formulate open-ended research questions suitable for inquiry and investigation and adjust questions as necessary while research is conducted. (Research A, 11-12)*
- *Compile, organize and evaluate information, take notes and summarize findings. (Research B, 11-12)*

Correlated Mathematics Academic Content Benchmarks

- *Construct convincing arguments based on analysis of data and interpretations of graphs. (Data F, 8-10)*
- *Evaluate the validity of claims and predictions that are based on data by examining the appropriateness of the data collections and analysis. (Data E, 8-10)*
- *Present complete and convincing arguments and justifications, using inductive and deductive reasoning, adapted to be effective for various audiences. (Math. Process F, 11-12)*

BIL: **Essential:** **PSD**

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Competency 8.2: Develop system framework

Descriptors:

- 8.2.1 Identify constraints (e.g., political, financial, time, hardware, and systems)
- 8.2.2 Select programming language (PSD)
- 8.2.3 Select hardware platform (PSD)
- 8.2.4 Identify and utilize standards and policies as required to govern the development of organizational information technology
- 8.2.5 Select tool sets (e.g., code libraries, downloadable classes, testing tools, frameworks) [PSD]
- 8.2.6 Identify source code control (PSD)
- 8.2.7 Identify communication plan (PSD)

BIL: **Essential:** **PSD**

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Competency 8.3: Design applications

Descriptors:

- 8.3.1 Identify processing requirements (PSD)

- 8.3.2 Create specs with development team (PSD)
- 8.3.3 Divide design specifications into logical blocks (e.g., flowchart, dataflow diagram, process flow, UML) [PSD]
- 8.3.4 Establish input and output (I/O) requirements (e.g., initiative user interface, report designs, menus, data communications, handhelds, robotics) [PSD]
- 8.3.5 Design system input/output processes
- 8.3.6 Define configuration data
- 8.3.7 Integrate approved data model into design process
- 8.3.8 Prepare logic using program flowchart (PSD)
- 8.3.9 Differentiate between system documentation and user documentation
- 8.3.10 Integrate data model
- 8.3.11 Define test scenarios to be developed
- 8.2.12 Organize and present system design deliverables

Correlated English Language Arts Academic Content Benchmarks

- *Formulate writing ideas and identify a topic appropriate to the purpose and audience.* (Writing Process A, 8-10; Writing Process A, 11-12)
- *Select and use an appropriate organizational structure to refine and develop ideas for writing.* (Writing Process B, 11-12)
- *Produce functional documents that report, organize and convey information and ideas accurately, foresee readers’ problems or misunderstandings and include formatting techniques that are user friendly.* (Writing Applications C, 11-12)

BIL: Essential: PSD

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Competency 8.4: Develop a series of programs that interact with one another in accordance with programming theory and software development techniques to solve the business problem

Descriptors:

- 8.4.1 Apply established operating system development tools, commands, utilities, and standards (e.g., naming conventions, indicative data names)
- 8.4.2 Evaluate operating system and network system constraints
- 8.4.3 Implement a simple hierarchy chart /design flowchart (PSD)
- 8.4.4 Utilize standards when writing source code (PSD)
- 8.4.5 Develop programs utilizing appropriate software development techniques(e.g., looping, arrays, functions)
- 8.4.6 Develop programs using file-handling techniques (e.g., config files, .ini files, text files)
- 8.4.7 Develop user interfaces (PSD)

- 8.4.8 Develop programs that interface with a data store
- 8.4.9 Implement temporary files, e.g., views, cursor files)
- 8.4.10 Design reports in accordance with system design and user specifications
- 8.4.11 Write code to instantiate and print report objects upon user request
- 8.4.12 Code error-handling techniques
- 8.4.13 Review/Update system level documentation
- 8.4.14 Write callable subroutines, components, and classes

Correlated Mathematics Academic Content Benchmarks

- *Translate information from one representation (words, table, graph or equation) to another representation of a relation or function. (Algebra C, 8-10)*

BIL: Essential: PSD

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Competency 8.5: Develop a system test plan

Descriptors:

- 8.5.1 Design/confirm system test plan
- 8.5.2 Create test data/results (PSD)
- 8.5.3 Execute the system test plan
- 8.5.4 Validate results (PSD)
- 8.5.5 Make changes as required (PSD)
- 8.5.6 Obtain user signoff

Correlated Mathematics Academic Content Benchmarks

- *Evaluate the validity of claims and predictions that are based on data by examining the appropriateness of the data collection and analysis. (Data E, 8-10)*
- *Describe sampling methods and analyze the effects of method chosen on how well the resulting sample represents the population. (Data G, 8-10)*
- *Use descriptive statistics to analyze and summarize data, including measures of center, dispersion, correlation and variability. (Data B, 11-12)*

BIL: **Essential:** **ISS, PSD**

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Competency 8.6: Develop user application documentation

Descriptors:

- 8.6.1 Identify documentation needs (ISS, PSD)
- 8.6.2 Prepare user documentation (e.g., user manuals, help screens) [ISS]
- 8.6.3 Prepare system/process flow diagrams (PSD)
- 8.6.4 Establish documentation-update method

Correlated English Language Arts Academic Content Benchmarks

- *Produce functional documents that report, organize and convey information and ideas accurately, foresee readers’ problems or misunderstandings and include formatting techniques that are user friendly. (Writing Applications C, 11-12)*

BIL: **Essential:** **ISS, PSD**

EDU:	10	12	AD
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Competency 8.7: Install application

Descriptors:

- 8.7.1 Review organizational structure
- 8.7.2 Create and test deployment media
- 8.7.3 Design implementation plan (PSD)
- 8.7.4 Present implementation plan to users and management
- 8.7.5 Perform implementation or changeover to new system
- 8.7.6 Perform post-implementation evaluation of new system
- 8.7.7 Correct deficiencies
- 8.7.8 Train personnel
- 8.7.9 Identify ongoing support requirements (PSD)

Correlated English Language Arts Academic Content Benchmarks

- *Give presentations using a variety of delivery methods, visual displays and technology.* (Communication G, 8-10; Communication F, 11-12)
- *Analyze the features and structures of documents and critique them for their effectiveness.* (Reading: Informational Text A, 11-12)
- *Produce functional documents that report, organize and convey information and ideas accurately, foresee readers' problems or misunderstandings and include formatting techniques that are user friendly.* (Writing Applications C, 11-12)

BIL: **Essential:** **PSD**
Recommended: **ISS, NS**

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Competency 8.8: Execute software product release and follow-up

Descriptors:

- 8.8.1 Obtain user acceptance
- 8.8.2 Participate in development of release plan
- 8.8.3 Train technical support staff
- 8.8.4 Facilitate transition to the new system release
- 8.8.5 Participate in development of a user-training plan (PSD)
- 8.8.6 Evaluate defects (PSD)
- 8.8.7 Repair defects (PSD)
- 8.8.8 Document defects and repairs (PSD)
- 8.8.9 Implement enhancements
- 8.8.10 Evaluate enhancements
- 8.8.11 Document enhancements
- 8.8.12 Obtain user feedback
- 8.8.13 Evaluate users' concerns
- 8.8.14 Respond to users' concerns

Correlated English Language Arts Academic Content Benchmarks

- *Produce functional documents that report, organize and convey information and ideas accurately foresee readers' problems or misunderstandings and that include formatting techniques that are user friendly.* (Writing Applications C, 11-12)
- *Give informational presentations that present ideas in a logical sequence, include relevant facts and details from multiple sources and use a consistent organizational structure.* (Communication E, 8-10)
- *Give presentations using a variety of delivery methods, visual displays and technology.* (Communication G, 8-10; Communication G, 11-12)

- *Select and use effective speaking strategies for a variety of audiences, situations and purposes.* (Communication C, 11-12)
- *Give informational presentations that contain a clear perspective, present ideas from multiple sources in logical sequence, and include a consistent organizational structure.* (Communication E, 11-12)

BIL: **Recommended: ISS, NS, PSD**

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Competency 8.9: Complete team software engineering project

Descriptors:

- 8.9.1 Discuss the principles and applications of the software development organizational team
- 8.9.2 Gather data to identify customer requirements
- 8.9.3 Estimate product life or customer application
- 8.9.4 Evaluate functional requirements
- 8.9.5 Interpret functional requirements analysis
- 8.9.6 Define scope of work to meet customer requirements
- 8.9.7 Identify time, technology, and resource constraints
- 8.9.8 Estimate project costs
- 8.9.9 Apply project planning and scheduling techniques to project development
- 8.9.10 Generate design alternatives
- 8.9.11 Evaluate design alternatives
- 8.9.12 Define system and software requirements
- 8.9.13 Validate system requirements
- 8.9.14 Establish measurable performance requirements
- 8.9.15 Develop software product and project documentation
- 8.9.16 Perform software product and project document composition and evaluation
- 8.9.17 Conduct software product testing and debugging
- 8.9.18 Conduct technical review

Correlated English Language Arts Academic Content Benchmarks

- *Analyze the features and structures of documents and critique them for their effectiveness.* (Reading: Informational Text A, 11-12)
- *Produce functional documents that report, organize and convey information and ideas accurately, foresee readers’ problems or misunderstandings and include formatting techniques that are user friendly.* (Writing Applications C, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Write and solve real-world, multi-step problems involving money, elapsed time and temperature, and verify reasonableness of solutions.* (Measurement F, 8-10)
- *Evaluate the validity of claims and predictions that are based on data by examining the appropriateness of the data collections and analysis.* (Data E, 8-10)
- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators.* (Data A, 11-12)
- *Connect statistical techniques to applications in workplace and consumer situations.* (Data D, 11-12)

BIL: **Essential:** **PSD**
Recommended: **ISS, NS**

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Competency 8.10: Apply quality standards

Descriptors:

- 8.10.1 Identify metrics for measurement (PSD)
 8.10.2 Establish baseline performance (PSD)
 8.10.3 Measure actual performance and baseline performance (PSD)

Correlated Mathematics Academic Content Benchmarks

- *Solve increasingly complex non-routine measurement problems and check for reasonableness of results.* (Measurement A, 8-10)
- *Explain difference among accuracy, precision and error, and describe how each of those can affect solutions in measurement situations.* (Measurement A, 11-12)
- *Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)

Unit 9: Web Site Development and Management

BIL: **Essential:** **PSD**

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Competency 9.1: Demonstrate knowledge of HTML fundamentals

Descriptors:

- 9.1.1 Create a basic HTML document that includes graphics and multimedia
- 9.1.2 Link Web documents
- 9.1.3 Utilize forms in an HTML document
- 9.1.4 Create and format a table in an HTML document

BIL: **Essential:** **PSD**

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Competency 9.2: Develop an Internet program

Descriptors:

- 9.2.1 Integrate scripting into an HTML document (PSD)
- 9.2.2 Employ object oriented techniques in Internet programming
- 9.2.3 Utilize volatile data storage techniques in Internet programming
- 9.2.4 Employ control structures in Internet programming
- 9.2.5 Create and call functions and procedures in Internet programming

BIL: **Essential:** **PSD**

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Competency 9.3: Demonstrate knowledge of content management

Descriptors:

- 9.3.1 Test site/application after content is updated to ensure integrity
- 9.3.2 Perform updates in a timely manner

- 9.3.3 Perform updates in accordance with application requirements
- 9.3.4 Update content only on appropriate pages in relevant objects of the database
- 9.3.5 Update and review links
- 9.3.6 Utilize appropriate tools to identify and update content
- 9.3.7 Backup site/application and data before performing updates
- 9.3.8 Log all update activities

BIL: **Essential:** **PSD**

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Competency 9.4: Demonstrate knowledge of Web application management

Descriptors:

- 9.4.1 Plan rollout and facilitate handoff to customer
- 9.4.2 Integrate customer feedback
- 9.4.3 Perform application maintenance (PSD)
- 9.4.4 Recommend optimization and facilitate upgrades and improvements
- 9.4.5 Monitor Web site performance metrics (PSD)

BIL: **Recommended: NS, PSD**

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Competency 9.5: Integrate scripting into an HTML document

Descriptors:

- 9.5.1 Explain the concept of scripting technologies
- 9.5.2 Identify scripting languages (e.g., Java script, VB script)
- 9.5.3 Explain client-side scripting
- 9.5.4 Insert a client-side script into a Web page
- 9.5.5 Insert comments into client-side script
- 9.5.6 Explain server-side script
- 9.5.7 Compare and contrast the server-side script to client-side script
- 9.5.8 Identify “server page” development technologies (e.g., JSP, ASP)
- 9.5.9 Insert server-side script into a Web page
- 9.5.10 Insert comments into server-side scripts
- 9.5.11 Develop criteria for selecting server-side or client-side script, given a Web page development task

Correlated English Language Arts Academic Content Benchmarks

- *Use multiple resources to enhance comprehension of vocabulary.* (Vocabulary E, 11-12)
- *Prepare writing for publication that follows an appropriate format and uses a variety of techniques to enhance the final product.* (Writing Process F, 11-12)

Unit 10: Web Site Development and Management – HTML Fundamentals

BIL: Recommended: ISS, NS

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Competency 10.1: Create a basic HTML document

Descriptors:

- 10.1.1 Explain the need for developers to create and maintain HTML script when utilizing Web document authoring tools that generate HTML script (e.g., ASP, .NET, Dreamweaver)
- 10.1.2 Discuss the basic principles of HTML, HTTP, and TCP/IP and their functional relationship with browsers
- 10.1.3 Plan a basic HTML document considering subject, audience, layout, color, links and graphics
- 10.1.4 Utilize HTML tags that display and format Web content to create a basic Web page in a text editor (e.g., <hx>, <p>,
)
- 10.1.5 Add documentation to the HTML document
- 10.1.6 Print an HTML document
- 10.1.7 Display a basic Web page on a browser that was created in a text editor
- 10.1.8 Evaluate functionality and features of downloadable freeware HTML authoring IDEs to create basic Web sites (e.g., Homesite, CuteHTML)
- 10.1.9 Create and add unordered lists to the HTML document with , tags
- 10.1.10 Create and add ordered lists to the HTML document utilizing the , tags

BIL: Recommended: ISS, NS

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Competency 10.2: Demonstrate knowledge of graphics and multimedia

Descriptors:

- 10.2.1 Insert and align inline graphics into an HTML document using the tag and the ALIGN attribute
- 10.2.2 Resize a graphic image in an HTML document utilizing the HEIGHT and WIDTH attributes

- 10.2.3 Explain the concept of an image map
- 10.2.4 Locate downloadable freeware that generates an image map for a given graphic (e.g., MapThis, MapIt)
- 10.2.5 Create an image map for a given graphic utilizing image map generation freeware, and insert the generated HTML into an HTML document
- 10.2.6 Insert audio into an HTML document by linking an image to an audio file utilizing a combination of the `` tag with the `` tag

BIL: **Recommended: ISS, NS**

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Competency 10.3: Link Web documents

Descriptors:

- 10.3.1 Link HTML document to other Web sites utilizing the `` tag configuration
- 10.3.2 Link HTML document to other HTML documents utilizing the `` tag configuration
- 10.3.3 Write an HTML anchor that links to another section of the same document
- 10.3.4 Link one Web page to another by clicking a graphic image utilizing a combination of the `` tag with the `` tag

BIL: **Recommended: ISS, NS**

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Competency 10.4: Utilize forms in an HTML document

Descriptors:

- 10.4.1 Discuss the concept of a form on a Web document and the various input tags that can be contained within the form (e.g., text entry fields, radio buttons)
- 10.4.2 Design a basic data entry HTML document containing forms from given specifications, with a variety of user input controls (e.g., text entry fields, radio buttons)
- 10.4.3 Write the HTML code to add a form to an HTML document by using the `<form>` tag and the selected ACTION or METHOD attributes
- 10.4.4 Write the HTML code for a text entry field contained within a form on an HTML document utilizing the `<input type="text" ...>` tag and relevant attributes
- 10.4.5 Write the HTML code for radio buttons contained within a form on an HTML document utilizing the `<input type="radio" ...>` tag and relevant attributes

- 10.4.6 Write the HTML code for a check box button(s) contained within a form on an HTML document utilizing the <input type="checkbox"...> tag and relevant attributes
- 10.4.7 Write the HTML code for a pull-down menu contained within a form on an HTML document utilizing the <select name...> tag and <option select...> tag and relevant attributes
- 10.4.8 Write the HTML code for a scroll box contained within a form on an HTML document utilizing the <select name...size=...> tag and <option select...> tag and relevant attributes
- 10.4.9 Code selected default values for all input tags
- 10.4.10 Write the HTML code for a pull-down menu contained within a form on an HTML document utilizing the <select name...> tag and <option select...> tag and relevant attributes
- 10.4.11 Discuss the concept and function of a push (submit) button
- 10.4.12 Write the HTML code for a submit button contained within a form on an HTML document utilizing the <input type="submit"...> tag and relevant attributes

BIL: **Recommended: ISS, NS**

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Competency 10.5: Create and format a table on an HTML document

Descriptors:

- 10.5.1 Write the HTML code to insert a table in an HTML document utilizing the <table > tag
- 10.5.2 Utilize the <tr> and <td> tags to create table rows and columns on a Web document
- 10.5.3 Enlarge a row to several columns by utilizing the ROWSPAN attribute on an HTML document
- 10.5.4 Enlarge a column on a table by combining it with adjacent cells with the COLSPAN attribute on an HTML document
- 10.5.5 Enlarge a row on a table by combining it with adjacent cells with the ROWSPAN attribute on an HTML document
- 10.5.6 Format a border on a table utilizing the BORDER= and BORDERCOLOR= table attributes on an HTML document
- 10.5.7 Align text on a table utilizing the ALIGN = attribute of the <td> and <tr> tags on an HTML document
- 10.5.8 Add color to table rows utilizing the BGCOLOR= attribute of the <tr> tag on an HTML document
- 10.5.9 Discuss the concept of table sizing on an HTML document
- 10.5.10 Control the dimensions of a table by utilizing the CELLPADDING= and WIDTH= table attributes of an HTML document

Unit 11: Web Site Development: Content Development and Technical Analysis

(Based on NSSB Information & Communications Technology Skill Standards)

BIL: **Essential:** **IM**

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Competency 11.1: Gather data and identify customer requirements and scope of work

Descriptors:

- 11.1.1 Define audience and mission in accordance with client procedures
- 11.1.2 Utilize affordable, reliable and relevant sources and methods for gathering requirements
- 11.1.3 Specify requirements and scope of work assuring they are accurate, complete, documented, updated on a regular basis and stored in an accessible and readable knowledge base for future reference
- 11.1.4 Gather information regarding global considerations (e.g., time zones, language, cultural sensitivities)

Correlated English Language Arts Academic Content Benchmarks

- *Compile, organize and evaluate information, take notes and summarize findings.* (Research B, 11-12)
- *Evaluate the usefulness and credibility of data and sources, and synthesize information from multiple sources.* (Research C, 11-12)

BIL: **Essential:** **IM**

EDU:	10	12	AD
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Competency 11.2: Review technical information and restraints

Descriptors:

- 11.2.1 Consider technical factors (e.g., server load, screen resolution, hard drive space, bandwidth, database performance) [IM]
- 11.2.2 Consider and address feasibility, usability, extensibility and maintenance issues (IM)
- 11.2.3 Assess budget and equipment constraints and approvals (IM)

- 11.2.4 Research and compare software tools as to their effectiveness for the work to be done and ability to integrate into the existing organization system (IM)
- 11.2.5 Research and consider accessibility laws, privacy laws, and regulatory issues (IM)
- 11.2.6 Assess implementation risk and communicate to appropriate personnel (IM)
- 11.2.7 Research and address system performance and availability requirements (IM)

Correlated English Language Arts Academic Content Benchmarks

- *Organize information from various resources and select appropriate sources to support central ideas, concepts and themes. (Research C, 8-10)*
- *Compile, organize and evaluate information, take notes and summarize findings. (Research B, 11-12)*
- *Evaluate the usefulness and credibility of data and sources, and synthesize information from multiple sources. (Research C, 11-12)*

BIL: **Essential:** **IM**

EDU:	10	12	AD
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IM		I	P

Competency 11.3: Develop, present, and assess concept alternatives

Descriptors:

- 11.3.1 Present an appropriate number of concepts to all relevant stakeholders (IM)
- 11.3.2 Resolve conflicts among key stakeholders (IM)
- 11.3.3 Present concept alternatives for developing an effective solution (IM)
- 11.3.4 Consider and document technology alternatives (IM)
- 11.3.5 Choose and document the appropriate solution (IM)
- 11.3.6 Evaluate the alternatives against the selection criteria (IM)

BIL: **Essential:** **IM**

EDU:	10	12	AD
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IM		I	P

Competency 11.4: Prepare preliminary application

Descriptors:

- 11.4.1 Organize content information in order to meet application objectives (IM)
- 11.4.2 Gather a consensus among all stakeholders regarding the organization of information and the look and feel of the product (IM)

11.4.3 Follow company guidelines and practices in preparation of the preliminary application (IM)

BIL: **Essential:** **IM**

EDU:	10	12	AD
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IM		I	P

Competency 11.5: Prepare functional, content, testing and technical specifications

Descriptors:

- 11.5.1 Prepare functional, content, testing and technical specifications to include detail on all product features (IM)
- 11.5.2 Present functional, content, testing and technical specifications in a clear and precise manner (IM)
- 11.5.3 Publish and regularly update functional, content, testing and technical specifications (IM)
- 11.5.4 Describe the operating system in functional, content, testing and technical specifications (IM)
- 11.5.5 Integrate and analyze customer and end-user needs into technical specifications (IM)
- 11.5.6 Describe software, communication protocols and programming languages in technical specifications (IM)

Correlated Mathematics Academic Content Benchmarks

- *Use of variety of mathematical representations flexibly and appropriately to organize, record and communicate mathematical ideas. (Math. Process E, 8-10)*
- *Communicate mathematical ideas orally and in writing with a clear purpose and appropriate for a specific audience. (Math. Process I, 11-12)*

BIL: **Essential:** **IM**

EDU:	10	12	AD
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Competency 11.6: Create and refine preliminary design or prototype

Descriptors:

- 11.6.1 Represent all required design features in a prototype (IM)
- 11.6.2 Include representative functional features in a prototype (IM)

- 11.6.3 Review and refine the prototype based on customer feedback, new information and technical considerations (IM)
- 11.6.4 Evaluate the effectiveness of the software tools chosen for the project in the prototype (IM)
- 11.6.5 Complete prototype on schedule (IM)

BIL: **Essential:** **IM**

EDU:	10	12	AD
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IM		I	P

Competency 11.7: Develop project plan

Descriptors:

- 11.7.1 Identify key stakeholder requirements in the project plan (IM)
- 11.7.2 Include project schedules, resource allocations, dependencies, milestones, functional and technical specifications, all data models, site maps, constraints and risks in the project plan (IM)
- 11.7.3 Include thorough testing of the solution and presentation of testing results in the project plan (IM)
- 11.7.4 Include all specifications in the project plan (IM)
- 11.7.5 Determine how documentation will be conducted in the project plan (IM)
- 11.7.6 Document and regularly update the project plan throughout the project life cycle in a previously determined format (IM)
- 11.7.7 Distribute project plan according to company procedures (IM)

Correlated English Language Arts Academic Content Benchmarks

- *Prepare writing for publication that follows an appropriate format and uses a variety of techniques to enhance the final product.* (Writing Process F, 11-12)
- *Compile, organize and evaluate information, take notes and summarize findings.* (Research B, 11-12)

Unit 12: Web Site Development: Develop and Design Web Applications and Sites

(Based on NSSB Information & Communications Technology Skill Standards)

BIL: Recommended: IM

EDU:	10	12	AD
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IM		I	P

Competency 12.1: Develop Web site architecture, application models and user interface specifications

Descriptors:

- 12.1.1 Develop consensus among all relevant key stakeholders regarding the organization of information and the look and feel of the end product
- 12.1.2 Develop system interactions and sequence diagrams
- 12.1.3 Develop site map, application models, image and page templates to meet project goals, user needs and application objectives
- 12.1.4 Develop site maps and application models in accordance with company standards and industry best practices
- 12.1.5 Review existing documentation
- 12.1.6 Employ file management procedures in accordance with organization protocols
- 12.1.7 Obtain approvals on final site map prior to implementing any design

BIL: Recommended: IM

EDU:	10	12	AD
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IM		I	P

Competency 12.2: Choose an architecture

- 12.2.1 Research, document and rate main alternatives according to best match with current project
- 12.2.2 Outline and present alternative technical and design scenarios
- 12.2.3 Analyze tradeoffs and risks of all alternatives
- 12.2.4 Seek review and approval of selected alternative by management and all members of the team
- 12.2.5 Assure selected alternative meets functionality, timeline and budget requirements
- 12.2.6 Document selected alternative in a clear and detailed form

BIL: **Recommended: IM**

EDU:	10	12	AD
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IM		I	P

Competency 12.3: Select programming languages, design tools and applications

Descriptors:

- 12.3.1 Select tools and applications based on functional requirements and technical and company specifications (e.g., frameworks, graphics designers, code generators)
- 12.3.2 Properly assess and evaluate third-party applications
- 12.3.3 Survey existing employee skill sets to determine tool and programming language selection
- 12.3.4 Test new tools and program languages to assure compatibility with pre-existing tools and existing company computing equipment
- 12.3.5 Determine and document the selected programming language compatibility with the browser, existing devices and operating system
- 12.3.6 Determine and document the selected programming language’s ability to support object orientation according to industry standards

BIL: **Recommended: IM**

EDU:	10	12	AD
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Competency 12.4: Write supporting code

Descriptors:

- 12.4.1 Determine if code meets project objectives, functional specifications, best practices and in-house coding guidelines
- 12.4.2 Design code that promotes efficient application performance and is easily maintained and debugged
- 12.4.3 Document code to ensure maintainability and upgradeability
- 12.4.4 Stub test and document code in accordance with company procedures
- 12.4.5 Research, test and document user interface usability
- 12.4.6 Analyze and resolve any errors in a timely and cost-effective manner
- 12.4.7 Construct large-scale test scenarios

BIL: **Recommended: IM**

EDU:	10	12	AD
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IM		I	P

Competency 12.5: Analyze major subsystems and interfaces

Descriptors:

- 12.5.1 Define and delineate all major subsystems and interfaces
- 12.5.2 Minimize overlap and interaction between major subsystems
- 12.5.3 Test for compatibility of application subsystems and interfaces
- 12.5.4 Document major subsystems and interfaces
- 12.5.5 Document interactions with subsystems and interfaces

BIL: **Recommended: IM**

EDU:	10	12	AD
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IM		I	P

Competency 12.6: Develop models

Descriptors:

- 12.6.1 Define scope and purpose of models
- 12.6.2 Develop models that are cost-effective and completed on schedule
- 12.6.3 Develop models that are representative of design and functionality
- 12.6.4 Exercise models and test for performance
- 12.6.5 Document-model development procedures, test results and recommendations
- 12.6.6 Develop models to reflect all aspects of the project including the business, interface and data

BIL: **Recommended: IM**

EDU:	10	12	AD
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IM		I	P

Competency 12.7: Develop design and interface specifications

Descriptors:

- 12.7.1 Seek approval of design and interface specifications by all relevant parties

- 12.7.2 Check and correct design and interface specifications for conflicts
- 12.7.3 Assess design and interface specifications for ease and quality of implementation
- 12.7.4 Document design and interface specifications
- 12.7.5 Develop and diagram entity relationships

BIL: **Recommended: IM**

EDU:	10	12	AD
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IM		I	P

Competency 12.8: Identify system platform components and dependencies

Descriptors:

- 12.8.1 Clearly delineate system platform components and dependencies
- 12.8.2 Document reasons for constraints
- 12.8.3 Delineate all components and interfaces to ensure a minimum of overlap and interaction between components
- 12.8.4 Identify and document long-term usability and future upgrade requirements

BIL: **Recommended: IM**

EDU:	10	12	AD
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IM		I	P

Competency 12.9: Link and develop supporting database

Descriptors:

- 12.9.1 Establish and define links between Web applications and associated databases
- 12.9.2 Develop protocols in accordance with company procedures
- 12.9.3 Assist database developers in meeting project specifications
- 12.9.4 Develop database functionality to meet project specifications
- 12.9.5 Utilize fundamental database concepts

Unit 13: Implement and Maintain Applications

(Based on NSSB Information & Communications Technology Skill Standards)

BIL: Recommended: ISS

EDU:	10	12	AD
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Competency 13.1: Plan rollout and facilitate handoff to customer

Descriptors:

- 13.1.1 Include overall project goals and timelines in rollout plan
- 13.1.2 Communicate rollout plans to key stakeholders in a timely manner
- 13.1.3 Conduct final review and approvals according to company standards
- 13.1.4 Identify support staff, training needs, and contingency plans in the rollout plan
- 13.1.5 Document contingency plan that is user-friendly
- 13.1.6 Test project for errors and seek all approvals prior to delivery to customer
- 13.1.7 Test delivered application to assure that it is fully functional for the customer/user and meets all requirements
- 13.1.8 Deliver support and training materials

Correlated English Language Arts Academic Content Benchmarks

- *Give informational presentations that contain a clear perspective, present ideas from multiple sources in logical sequence and include a consistent organizational structure.* (Communication E, 11-12)

BIL: Recommended: ISS

EDU:	10	12	AD
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Competency 13.2: Integrate customer feedback

Descriptors:

- 13.2.1 Gather and document customer feedback on a continuous basis
- 13.2.2 Act upon user feedback after analysis, prioritization and review for interdependencies
- 13.2.3 Document changes
- 13.2.4 Inform customers of applications changes and updates
- 13.2.5 Execute change orders in accordance with company procedures to determine project costs and communicate to client

Correlated English Language Arts Academic Content Benchmarks

- *Use a variety of strategies to enhance listening comprehension.* (Communication A, 11-12)
- *Select and use effective speaking strategies for a variety of audiences, situations and purposes.* (Communication C, 11-12)

BIL: **Recommended: ISS**

EDU:	10	12	AD
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Competency 13.3: Perform application maintenance

Descriptors:

- 13.3.1 Identify, research, document and resolve problems in a timely manner
- 13.3.2 Modify changes to applications in a timely and cost-effective manner and track in application life cycle
- 13.3.3 Enhance applications without interruption of service
- 13.3.4 Meet customer internal, external and global expectations in a timely manner
- 13.3.5 Back up applications and related data
- 13.3.6 Prepare a plan for disaster recovery
- 13.3.7 Document modifications to applications
- 13.3.8 Archive older versions of applications
- 13.3.9 Document interactions resulting in applications changes

BIL: **Recommended: ISS**

EDU:	10	12	AD
ISS		I	R
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Competency 13.4: Recommend optimization and facilitate upgrades and improvement

Descriptors:

- 13.4.1 Gather and document customer feedback and evaluate for feasibility
- 13.4.2 Develop recommendation for on-site improvements along with associated budget considerations
- 13.4.3 Present recommendations to key stakeholders in accordance with company procedures
- 13.4.4 Identify and consider risk assessment
- 13.4.5 Test system operation specifications under heavy traffic and load conditions

- 13.4.6 Apply performance metrics to system optimization
- 13.4.7 Document installation and configuration procedures to aid maintainability and repetition

Correlated English Language Arts Academic Content Benchmarks

- *Compile, organize and evaluate information, take notes and summarize findings.* (Research B, 11-12)
- *Use a variety of strategies to enhance listening comprehension.* (Communication A, 11-12)
- *Select and use effective speaking strategies for a variety of audiences, situations and purposes.* (Communication C, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Formulate a problem or mathematical model in response to a specific need or situation, determine information required to solve the problem, choose method for obtaining this information, and set limits for acceptable solution.* (Math. Process A, 8-10)
- *Apply mathematical modeling to workplace and consumer situations, including problem formulation, identification of a mathematical model, interpretation of solution within the model, and validation to original problem situation.* (Math. Process J, 11-12)

BIL: Recommended: ISS

EDU:	10	12	AD
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Competency 13.5: Administer content

Descriptors:

- 13.5.1 Test site/application after content is updated to ensure integrity
- 13.5.2 Perform updates in a timely manner
- 13.5.3 Perform updates in accordance with application requirements
- 13.5.4 Update content only on appropriate pages in relevant objects of the database
- 13.5.5 Update and review links
- 13.5.6 Utilize appropriate tools to identify and update content
- 13.5.7 Backup site/application and data before performing updates
- 13.5.8 Log all update activities

BIL: **Recommended: ISS**

EDU:	10	12	AD
ISS		I	R
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Competency 13.6: Document application and site changes as it applies to the system environment and application version

Descriptors:

- 13.6.1 Document all changes in accordance with documentation procedures and standards
- 13.6.2 Distribute change documentation in a timely manner to relevant personnel and/or departments
- 13.6.3 Develop and follow change procedures
- 13.6.4 Include backup versions with documented site changes

BIL: **Recommended: ISS**

EDU:	10	12	AD
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Competency 13.7: Monitor performance metrics

Descriptors:

- 13.7.1 Minimize system down time
- 13.7.2 Collect and document systematic and ongoing measurement data
- 13.7.3 Identify and update metrics
- 13.7.4 Monitor and print usage logs on a regular basis in accordance with company procedures
- 13.7.5 Monitor system for intrusions and denial-of-service attacks
- 13.7.6 Measure performance statistics using a variety of hardware systems and internal connections
- 13.7.7 Documents and archive metrics on a regular basis

Correlated Mathematics Academic Content Benchmarks

- *Evaluate the validity of claims and predictions that are based on data by examining the appropriateness of the data collection and analysis. (Data E, 8-10)*
- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators. (Data A, 11-12)*
- *Use descriptive statistics to analyze and summarize data, including measures of center, dispersion, correlations and variability. (Data B, 11-12)*

- *Design and perform a statistical experiment, simulation or study; collect and interpret data; and use descriptive statistics to communicate and support predictions and conclusions. (Data C, 11-12)*
- *Connect statistical techniques to applications in workplace and consumer situations. (Data D, 11-12)*
- *Apply mathematical modeling to workplace and consumer situations, including problem formulation, identification of a mathematical model, interpretation of solution within the model, and validation to original problem situation. (Math. Process J, 11-12)*

BIL: **Recommended: ISS**

EDU:	10	12	AD
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IM			

Competency 13.8: Implement and support changes in new technology

Descriptors:

- 13.8.1 Implement changes in a timely manner
- 13.8.2 Test site/application to establish baseline before changes are incorporated
- 13.8.3 Evaluate appropriate browser and device types for functionality and compatibility with new technology
- 13.8.4 Verify changes in database functionality
- 13.8.5 Test site/application for performance, functionality and reliability after changes are completed
- 13.8.6 Document changes in accordance with company standards
- 13.8.7 Monitor site page bandwidth usage and customer feedback on a consistent basis and make adjustments accordingly
- 13.8.8 Archive older versions of applications

Unit 14: Multimedia Development: Performance Testing and Quality Assurance

(Based on NSSB Information & Communications Technology Skill Standards)

BIL: Recommended: IM

EDU:	10	12	AD
ISS			
NS			
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IM		I	P

Competency 14.1: Develop test and acceptance plan

Descriptors:

- 14.1.1 Create a written procedure agreed by the customer and the project team for determining the acceptability of the project deliverables
- 14.1.2 Develop test and acceptance plan that is completed and documented in accordance with applicable policies and baseline tests
- 14.1.3 Develop a test plan that is relevant to the application and assure requirements are in compliance with legal and customer requirements
- 14.1.4 Develop a test system that accurately mimics external interfaces
- 14.1.5 Develop realistic test cases that compare with expected performance and include all browser and device types
- 14.1.6 Identify testing resources and establish a schedule
- 14.1.7 Seek customer acceptance upon successful completion of the test plan

Correlated English Language Arts Academic Content Benchmarks

- *Produce functional documents that report, organize and convey information and ideas accurately, foresee readers' problems or misunderstandings and include formatting techniques that are user friendly.* (Writing Applications C, 11-12)

BIL: Recommended: IM

EDU	10	12	AD
ISS			
NS			
PSD			
IM		I	P

Competency 14.2: Develop test procedures and performance assessment requirements

Descriptors:

- 14.2.1 Develop test procedures that explicitly verify specifications
- 14.2.2 Develop test procedures that define test conditions
- 14.2.3 Document testing procedures
- 14.2.4 Develop appropriate tests for individual components and end-to-end operations

Correlated Mathematics Academic Content Benchmarks

- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators. (Data A, 11-12)*

BIL: **Essential:** **IM**

EDU:	10	12	AD
ISS			
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IM		I	P

Competency 14.3: Develop and perform usability and testing integration

Descriptors:

- 14.3.1 Provide individuals from the representative user community opportunities to interact with product (IM)
- 14.3.2 Observe and document user while using the product (IM)
- 14.3.3 Convey information of usability test to development team/ or have development team attend usability testing sessions (IM)
- 14.3.4 Resolve any problems that are indicated from usability test results (IM)
- 14.3.5 Maintain test data and documentation over time for accessibility to the development team (IM)
- 14.3.6 Describe test routines and procedures for applicability efficiency (IM)
- 14.3.7 Identify appropriate metrics for the tests based on user task analysis findings (IM)
- 14.3.8 Repeat usability testing as necessary after product revisions (IM)

Correlated Mathematics Academic Content Benchmarks

- *Describe sampling methods and analyze the effects of method chosen on how well the resulting sample represents the population. (Data G, 8-10)*

BIL: **Essential:** **IM**

EDU:	10	12	AD
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PSD			
IM		I	P

Competency 14.4: Complete performance test process

Descriptors:

- 14.4.1 Identify appropriate team members in test process (IM)
- 14.4.2 Test system according to plan and schedule (IM)
- 14.4.3 Document test results and communicate as appropriate (IM)

- 14.4.4 Perform system integration testing and volume/performance testing when appropriate (IM)
- 14.4.5 Repeat testing after all major program modifications (IM)

BIL: **Recommended: IM**

EDU:	10	12	AD
ISS			
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PSD			
IM		I	P

Competency 14.5: Recommend and implement performance improvement

- 14.5.1 Codify and analyze performance metrics for effective decision support
- 14.5.2 Actively solicit customer feedback to be maintained and applied to performance reviews
- 14.5.3 Prepare application improvement plans based on performance reviews and business goals
- 14.5.4 Compare performance analysis to previous tests after implementing performance improvements

Correlated Mathematics Academic Content Benchmarks

- *Evaluate the validity of claims and predictions that are based on data by examining the appropriateness of the data collection and analysis. (Data E, 8-10)*
- *Construct convincing arguments based on analysis of data and interpretation of graphs. (Data F, 8-10)*

BIL: **Recommended: IM**

EDU:	10	12	AD
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PSD			
IM		I	P

Competency 14.6: Provide quality customer service

Descriptors:

- 14.6.1 Manage customer relationship and communications so that customers are satisfied with current level of service
- 14.6.2 Meet internal, external and global customer expectations in a timely manner
- 14.6.3 Identify problems and refer to appropriate personnel in a timely manner
- 14.6.4 Adjust communications to fit the audience
- 14.6.5 Evaluate customer feedback to determine the source of any confusion or concerns

- 14.6.6 Address and resolve customer concerns concerning site/applications to avoid repeated complaints
- 14.6.7 Communicate customer service contact information clearly to customers in a timely manner

Correlated English Language Arts Academic Content Benchmarks

- *Use a variety of strategies to enhance listening comprehension.* (Communication, A, 8-10; Communication A, 11-12)
- *Demonstrate an understanding of effective speaking strategies by selecting appropriate language and adjusting presentation techniques.* (Communication D, 8-10)
- *Give presentations using a variety of delivery methods, visual displays and technology.* (Communication G, 8-10; Communication F, 11-12)
- *Select and use effective speaking strategies for a variety of audiences, situations and purposes.* (Communication C, 11-12)

Unit 15: Basic Mainframe Concepts

BIL: **Essential:** **PSD**
Recommended: **ISS**

EDU:	10	12	AD
ISS		I	R
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PSD		I	P
IM			

Competency 15.1: Demonstrate knowledge of enterprise systems

Descriptors:

- 15.1.1 Identify types of mainframe memory storage techniques architecture
- 15.1.2 Identify data storage techniques used by mainframe operation (PSD)
- 15.1.3 Explain how data is stored in mainframe computer memory (PSD)
- 15.1.4 Explain how a mainframe computer system executes program instructions
- 15.1.5 Discuss mainframe storage capacity

BIL: **Recommended:** **PSD**

EDU:	10	12	AD
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Competency 15.2: Design multi-tiered applications

- 15.2.1 Discuss the features, functions, and architectures of client/server computing
- 15.2.2 Define the objectives of a client/server application
- 15.2.3 Analyze design requirements
- 15.2.4 Perform a logical design
- 15.2.5 Specify needed technology
- 15.2.6 Identify appropriate migration strategies
- 15.2.7 Implement online transaction processing (OLTP)
- 15.2.8 Design online analytical processing (OLAP) for data warehousing
- 15.2.9 Design static and dynamic online processing systems (OLIP/OLAP)
- 15.2.10 Employ interface techniques

BIL: **Recommended: PSD**

EDU:	10	12	AD
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PSD			I
IM			

Competency 15.3: Set up mainframe database systems

Descriptors:

- 15.3.1 Create client application resources (e.g., icons, menus, windows, dialogs)
- 15.3.2 Set up/modify database
- 15.3.3 Build a help system
- 15.3.4 Connect heterogeneous databases
- 15.3.5 Prepare reports using mainframe database

Correlated English Language Arts Academic Content Benchmarks

- *Use a variety of strategies to revise content, organization and style, and to improve word choice, sentence variety, clarity and consistency of writing. (Writing Process C, 11-12)*
- *Produce informational essays or reports that establish a clear and distinctive perspective on the subject, include relevant perspectives, take into account the validity and reliability of sources and provide a clear sense of closure. (Writing Applications D, 11-12)*

BIL: **Recommended: ISS, PSD**

EDU:	10	12	AD
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PSD			I
IM			

Competency 15.4: Operate mainframe computer systems

Descriptors:

- 15.4.1 Interpret terminology associated with mainframe computer operation
- 15.4.2 Identify data requirements
- 15.4.3 Access needed information using standard references and sources
- 15.4.4 Perform logon procedures
- 15.4.5 Respond to system messages
- 15.4.6 Follow processing procedures for each application/job
- 15.4.7 Determine scheduling priority
- 15.4.8 Develop audit trails
- 15.4.9 Develop a test system plan
- 15.4.10 Handle materials and equipment in a responsible manner
- 15.4.11 Define user interface standards

- 15.4.12 Build a job scheduler
- 15.4.13 Determine resources required to distribute the application

BIL: **Recommended: ISS, PSD**

EDU:	10	12	AD
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NS			
PSD			I
IM			

Competency 15.5: Maintain mainframe computer systems

Descriptors:

- 15.5.1 Solve recoverable problems
- 15.5.2 Maintain security
- 15.5.3 Maintain computer log
- 15.5.4 Perform backup procedure(s)
- 15.5.5 Follow logoff procedure(s)
- 15.5.6 Establish quality control standards

Unit 16: Hardware Design, Operation, and Maintenance

BIL: **Essential:** **ISS, NS**

EDU:	10	12	AD
ISS		P	R
NS		P	R
PSD			
IM			

Competency 16.1: Demonstrate proficiency in working with microcomputer systems

Descriptors:

- 16.1.1 Identify the essential components of microcomputers and the functions of each
- 16.1.2 Discuss the principles and operation of bus concepts (e.g., VESA, EISA)
- 16.1.3 Discuss the operating systems (e.g., Windows, *NIX, DOS)
- 16.1.4 List types of input and output devices and peripherals
- 16.1.5 Discuss the principles and operation of storage devices
- 16.1.6 Connect input and output ports to peripherals

BIL: **Essential:** **ISS**
Recommended: **NS**

EDU:	10	12	AD
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NS		P	R
PSD			
IM			

Competency 16.2: Demonstrate proficiency in working with basic computer system architecture

Descriptors:

- 16.2.1 Explain the principles and operation of addresses and interrupts
- 16.2.2 Discuss the principles and operation of volatile and nonvolatile memory

Correlated English Language Arts Academic Content Benchmarks

- *Apply knowledge of roots, affixes and phrases to aid understanding of content area vocabulary. (Vocabulary D, 11-12)*

BIL: **Essential:** **ISS, NS**

EDU:	10	12	AD
ISS		P	R
NS	I	P	R
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IM			

Competency 16.3: Explain the purpose and importance of hardware standards

Descriptors:

- 16.3.1 Identify standard-setting bodies, OSI, IEEE, ISO, and ITU-T (formerly CCITT) standards
- 16.3.2 Explain the purpose and importance of each standard setting body

BIL: **Essential:** **ISS, NS, IM**

EDU:	10	12	AD
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PSD			
IM		I	P

Competency 16.4: Identify common computing platforms

Descriptors:

- 16.4.1 Identify the basic features of standard microprocessors (e.g., Intel family, RISC, AMD) [IM]
- 16.4.2 Identify standard memory types (e.g., RAM, ROM, DDRAM) [IM]
- 16.4.3 Identify standard input/output devices (e.g., ISA, EISA, PCI, USB, drive controllers, SCSI, PCMCIA, firewire) [IM]
- 16.4.4 Identify the basic features of standard operating systems (e.g., Windows Macintosh OS; Solaris, Linux, UNIX) [IM]
- 16.4.5 Identify the basic features of standard workstations (IM)

BIL: **Essential:** **NS**
Recommended: **ISS**

EDU:	10	12	AD
ISS		I	R
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Competency 16.5: Analyze the computer site environment

Descriptors:

- 16.5.1 Identify environmental and structural requirements, conditions, and limitations (NS)
- 16.5.2 Identify power requirements and power supplies (NS)
- 16.5.3 Identify environmental standards and issues as they pertain to local, state, federal, global, and industry standards (NS)
- 16.5.4 Identify wiring specifications in compliance with state/local/federal codes (NS)
- 16.5.5 Identify physical site access and security (NS)

Correlated Mathematics Academic Content Benchmarks

- *Use algebraic representations, such as tables, graphs, expressions, functions and inequalities, to model and solve problem situations. (Algebra D, 8-10)*
- *Formulate a problem or mathematical model in response to a specific need or situation, determine information required to solve the problem, choose method for obtaining this information, and set limits for acceptable solution. (Math. Process A, 8-10)*

BIL: **Essential:** **ISS, NS**
Recommended: **PSD**

EDU:	10	12	AD
ISS		P	R
NS		P	R
PSD			I
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Competency 16.6: Classify computer architecture and processor types

Descriptors:

- 16.6.1 Compare/contrast the features of different microcomputer processors, minicomputer architecture and processors, and mainframe architecture and processors enterprise mid-range and personal computing
- 16.6.2 Identify internal system unit components
- 16.6.3 Compare/contrast system bus structures
- 16.6.4 Identify appropriate use of architecture alternatives

BIL: **Essential:** **ISS**
Recommended: **NS, PSD**

EDU:	10	12	AD
ISS		P	R
NS		I	R
PSD		I	R
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Competency 16.7: Classify computer systems

Descriptors:

- 16.7.1 Interpret terminology and acronyms related to computer systems architecture
- 16.7.2 Identify the input, process, output and storage hardware required in a system
- 16.7.3 Identify the basic organization of CPU architecture (e.g., Von Neumann, block diagram, data paths, control path, functional units, instruction cycles)
- 16.7.4 Compare/contrast multiprocessor architectures (e.g., single multiprocessing and distributed processing, stack, array, vector, multiprocessor, hypercube, client server, supercomputers)
- 16.7.5 Compare/contrast fundamentals of instruction-set types and architectures, including registers and RISC addressing modes
- 16.7.6 Compare/contrast of data-structure machine representations, including signed integers, character strings, stacks, records, and linked lists
- 16.7.7 Describe the principles and operation of volatile and nonvolatile memory
- 16.7.8 Discuss the principles and operation of advanced memory techniques
- 16.7.9 Identify standard input/output devices and systems, and IO subsystem
- 16.7.10 Describe the principles and operation of addresses and interrupt processing, and direct-memory-access data-handling system(s) [e.g., CICS]
- 16.7.11 Define functions of advanced memory techniques (e.g., virtual, pipeline, cache)
- 16.7.12 Demonstrate appropriate use of command sets to handle tasks in operating systems
- 16.7.13 Identify cost and performance issues in designing, building or upgrading a computer system

Correlated English Language Arts Academic Content Benchmarks

- *Use multiple resources to enhance comprehension of vocabulary.* (Vocabulary F, 8-10; Vocabulary E, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Write and solve real-world, multi-step problems involving money, elapsed time and temperature, and verify reasonable of solutions.* (Measurement F, 9-10)
- *Explain difference among accuracy, precision and error, and describe how each of those can affect solutions in measurement situations.* (Measurement A, 11-12)
- *Evaluate the validity of claims and predictions that are based on data by examining the appropriateness of the data collections and analysis.* (Data E, 8-10)
- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators.* (Data A, 11-12)

- *Apply mathematical knowledge and skills routinely in other content areas and practical situations. (Math. Process B, 8-10)*
- *Apply mathematical modeling to workplace and consumer situations, including problem formulation, identification of a mathematical model, interpretations of solution within the model, and validations to original problem situation. (Math. Process J, 11-12)*

BIL: **Essential:** **ISS**
Recommended: **NS, PSD**

EDU:	10	12	AD
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Competency 16.8: Identify and explain CPU and system components

Descriptors:

- 16.8.1 Explain CPU configuration and structure
- 16.8.2 Describe the characteristics of system boards
- 16.8.3 Describe the characteristics and operation of interface cards
- 16.8.4 Describe the characteristics and operation of the PCMCIA bus (PC Card and CardBus)
- 16.8.5 Differentiate between ROM, PROM, EPROM, EEPROM, RAM (including cache)
- 16.8.6 Differentiate between synchronous and asynchronous circuits

Correlated English Language Arts Academic Content Benchmarks

- *Apply knowledge of roots, affixes and phrases to aid understanding of content area vocabulary. (Vocabulary D, 11-12)*

BIL: **Essential:** **ISS, NS**
Recommended: **PSD**

EDU:	10	12	AD
ISS		P	R
NS		P	R
PSD			I
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Competency 16.9: Identify and describe connectivity devices

Descriptors:

- 16.9.1 Recognize the appropriate use, characteristics, and operations of network interface devices
- 16.9.2 Discuss the characteristics and operation of analog communication devices (e.g., multiplexers, modems, DSU)
- 16.9.3 Discuss the characteristics and operation of digital communication devices. (e.g., switches, routers, firewalls, and routers)

- 16.9.4 Discuss the operation of test equipment (e.g., protocol analyzers)
- 16.9.5 Discuss wireless technologies (e.g., 802.1x, CDMA, GSM, Microwave, RFID, Bluetooth)

Correlated Mathematics Academic Content Benchmarks

- *Compare, order and determine equivalent forms of real numbers.* (Number E, 8-10)
- *Explain the effects of operations on the magnitude of quantities.* (Number F, 8-10)
- *Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions.* (Number G, 8-10)

BIL: **Essential:** **ISS, NS**
Recommended: **PSD**

EDU:	10	12	AD
ISS		P	R
NS		P	R
PSD	I	R	R
IM			

Competency 16.10: Identify and describe peripheral equipment

Descriptors:

- 16.10.1 Describe storage system concepts and technologies
- 16.10.2 Identify interfaces between computers and other devices (e.g. Firewire, USB, IEEE, Serial ATA, SCSI)
- 16.10.3 Define printer types and related interface controllers
- 16.10.4 Define the use and operation of tape equipment and technologies
- 16.10.5 Compare and contrast RAID concepts

BIL: **Essential:** **ISS, NS**
Recommended: **PSD**

EDU:	10	12	AD
ISS		P	R
NS		P	R
PSD			I
IM			

Competency 16.11 Evaluate cost and performance issues in designing, building or upgrading a computer system

Descriptors:

- 16.11.1 Identify and document user hardware/software and network requirements
- 16.11.2 Evaluate and recommend products and services and associated costs
- 16.11.3 Identify upgrade costs and financial risks and risk management and business continuity

Correlated Mathematics Academic Content Benchmarks

- *Write and solve real-world, multi-step problems involving money, elapsed time and temperature, and verify reasonable of solutions.* (Measurement F, 9-10)
- *Explain difference among accuracy, precision and error, and describe how each of those can affect solutions in measurement situations.* (Measurement A, 11-12)
- *Evaluate the validity of claims and predictions that are based on data by examining the appropriateness of the data collections and analysis.* (Data E, 8-10)
- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators.* (Data A, 11-12)
- *Apply mathematical knowledge and skills routinely in other content areas and practical situations.* (Math. Process B, 8-10)
- *Apply mathematical modeling to workplace and consumer situations, including problem formulation, identification of a mathematical model, interpretations of solution within the model, and validations to original problem situation.* (Math. Process J, 11-12)

BIL: **Essential:** **ISS, NS, IM**

EDU:	10	12	AD
ISS		I	P
NS		I	P
PSD			
IM		I	P

Competency 16.12: Troubleshoot computer systems

Descriptors:

- 16.12.1 Test system using diagnostic tools/software (NS, ISS, IM)
- 16.12.2 Identify problems in the operating system and related hardware (NS, ISS, IM)
- 16.12.3 Differentiate between hardware and software failure (NS, ISS, IM)
- 16.12.4 Update flash memory (BIOS) [(NS)]
- 16.12.5 Optimize hard drive (NS, IM)
- 16.12.6 Gather information on problem from user (NS, ISS, IM)
- 16.12.7 Repair/replace malfunctioning hardware (NS, ISS)
- 16.12.8 Reinstall software as needed (NS, ISS)
- 16.12.9 Recover data and/or files (NS)
- 16.12.10 Restore system to normal operating standards (NS, ISS)

Correlated English Language Arts Academic Content Benchmarks

- *Use a variety of strategies to enhance listening comprehension.* (Communication A, 11-12)

Unit 17: Fundamentals of Electronics Technology

BIL: **Recommended:** NS

EDU:	10	12	AD
ISS			
NS		I	R
PSD			
IM			

Competency 17.1: Demonstrate an understanding of electrical fundamentals

Descriptors:

- 17.1.1 Identify electrical components and schematic symbols
- 17.1.2 Identify electrical components/values using color codes and symbols
- 17.1.3 Describe of basic atomic structure and its relationship to electricity
- 17.1.4 Describe the relationship between electrical and magnetic properties
- 17.1.5 Demonstrate the electrical and magnetic properties of a magnet
- 17.1.6 Demonstrate the photoelectric effect
- 17.1.7 Demonstrate the thermocouple and Peltier effects
- 17.1.8 Discuss electrical static charge and the role of friction
- 17.1.9 Follow electrostatic discharge (ESD) preventive procedures
- 17.1.10 Identify sources of electricity
- 17.1.11 Discuss the principles and operation of electrochemical supplies
- 17.1.12 Calculate voltage, current, resistance, power, and energy
- 17.1.13 Apply Ohm's law
- 17.1.14 Apply laws
- 17.1.15 Apply power formulas
- 17.1.16 Solve electronic unit problems using metric units

Correlated Mathematics Academic Content Benchmarks

- *Use algebraic representations, such as tables, graphs, expressions, functions and inequalities, to model and solve problem situations. (Algebra D, 8-10)*
- *Solve and graph linear equations and inequalities. (Algebra F, 8-10)*
- *Apply algebraic methods to represent and generalize problem situations involving vectors and matrices. (Algebra D, 11-12)*
- *Use scientific notation to express large numbers and numbers less than one. (Number A, 8-10)*
- *Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions. (Number G, 8-10)*
- *Estimate, compute and solve problems involving scientific notation, square roots and numbers with integer exponents. (Number I, 8-10)*
- *Use proportional reasoning and apply indirect measurement techniques, including right triangle trigonometry and properties of similar triangles, to solve problems involving measurements and rates. (Measurement D, 8-10)*
- *Apply factorials and exponents, including fractional exponents, to solve practical problems. (Number C, 8-10)*

BIL: **Recommended:** NS

EDU:	10	12	AD
ISS			
NS		I	R
PSD			
IM			

Competency 17.2: Demonstrate knowledge of operating the various types of equipment used to test/measure DC circuits, AC circuits, solid-state devices, digital circuits, analog circuits, and microprocessors

Descriptors:

- 17.2.1 Demonstrate the function and operation of an analog volt-ohm-meter (AVOM) [e.g., measure voltage, ohms, and amperage]
- 17.2.2 Demonstrate the function and operation of a digital volt-ohm-meter (DVOM) [e.g., measure voltage, ohms, and amperage]
- 17.2.3 Demonstrate the function and operation of a clamp-on amp meter
- 17.2.4 Demonstrate the function and operation of oscilloscopes (i.e., voltage over time)
- 17.2.5 Demonstrate the function and operation of a logic probe and logic analyzer
- 17.2.6 Measure properties of circuits using electrical test/measurement equipment
- 17.2.7 Troubleshoot a multi-component electrical circuit using electrical test/measurement equipment

Correlated Mathematics Academic Content Benchmarks

- *Write and solve real-world, multi-step problems involving money, elapsed time and temperature, and verify reasonable of solutions.* (Measurement F, 8-10)
- *Explain difference among accuracy, precision and error, and describe how each of those can affect solutions in measurement situations.* (Measurement A, 11-12)
- *Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)
- *Prove or disprove conjectures and solve problems involving two- and three-dimensional objects represented within a coordinate system.* (Geometry G, 8-10)

BIL: **Recommended:** NS

EDU:	10	12	AD
ISS			
NS		I	R
PSD			
IM			

Competency 17.3: Demonstrate proficiency in working with DC circuits

Descriptors:

- 17.3.1 Compute conductance of conductors and insulators
- 17.3.2 Measure resistance and current of conductors and insulators
- 17.3.3 Build series, parallel, and combination circuits

- 17.3.4 Build voltage divider circuits (loaded and unloaded)
- 17.3.5 Compute voltage divider circuits (loaded and unloaded)
- 17.3.6 Discuss the electromagnetic properties of circuits and devices
- 17.3.7 Discuss the physical and electrical characteristics of capacitors and inductors

Correlated Mathematics Academic Content Benchmarks

- *Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions.* (Number G, 8-10)
- *Represent and compute with complex numbers.* (Number E, 11-12)
- *Solve problems situations involving derived measurements; e.g., density, acceleration.* (Measurement D, 11-12)
- *Solve and graph linear equations and inequalities.* (Algebra F, 8-10)
- *Solve systems of linear equations involving two variables graphically and symbolically.* (Algebra H, 8-10)
- *Model and solve problem situations involving direct and inverse variation.* (Algebra I, 8-10)
- *Describe and interpret rates of change from graphical and numerical data.* (Algebra J, 8-10)

BIL: **Essential:** **NS**

EDU:	10	12	AD
ISS			
NS		I	P
PSD			
IM			

Competency 17.4: Demonstrate proficiency in working with AC circuits

Descriptors:

- 17.4.1 Discuss the principles and operational characteristics of sinusoidal and non-sinusoidal wave forms
- 17.4.2 List known AC sources (NS)
- 17.4.3 Explain the principles and operation of various power conditioning systems (e.g., isolation transformers, surge suppressors, uninterruptible power systems) [NS]
- 17.4.4 Discuss the principles and operation of various safety grounding systems (e.g., lightning arresters, ground electrostatic discharge, fault interrupters) [NS]
- 17.4.5 Measure voltage, current, time, frequency (f), and phase relationships of AC sine wave signal

Correlated Mathematics Academic Content Benchmarks

- *Translate information from one representation (words, table, graph, or equation) to another representation of a relation or function.* (Algebra C, 8-10)
- *Use algebraic representations, such as tables, graphs, expressions, functions and inequalities, to model and solve problem situations.* (Algebra D, 8-10)

- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators. (Data A, 11-12)*
- *Apply mathematical knowledge and skills routinely in other content areas and practical situations. (Math. Process, 8-10)*
- *Use formal mathematical language and notation to represent ideas, to demonstrate relationships within and among representation systems, and to formulate generalizations. (Math. Process, 11-12)*
- *Use right triangle trigonometric relationships to determine lengths and angle measures. (Geometry I, 8-10)*
- *Compare, order and determine equivalent forms of real numbers. (Number E, 8-10)*
- *Represent transformations within a coordinate system using vectors and matrices. (Geometry B, 11-12)*

Unit 18: Networking

BIL: **Essential:** **ISS, NS**
Recommended: **PSD**

EDU:	10	12	AD
ISS		I	P
NS		P	R
PSD		I	R
IM			

Competency 18.1: Demonstrate knowledge of basic network classifications and topologies

Descriptors:

- 18.1.1 Interpret basic networking terminology (ISS)
- 18.1.2 Differentiate between LANs, CANs, WANs, MANs) [ISS]
- 18.1.3 Describe how to turn LANs into CANs and WANs, MANs) [ISS]
- 18.1.4 Identify the basic point-to-point network topologies (e.g., star, ring, tree, network, irregular) [ISS]
- 18.1.5 Explain packet-switching techniques (ISS)
- 18.1.6 Identify the basic broadcast topologies (e.g., star ring, bus) [ISS]
- 18.1.7 Compare the characteristics of connection-oriented and connectionless protocols (ISS)
- 18.1.8 Identify standard high-speed networks (e.g., broadband, ISDN, SMDS, ATM, FDDI, DS3, SONET, Optical Carrier Systems) [ISS]
- 18.1.9 Identify emerging networks (e.g., ATM; ISDN; satellite nets; optic nets; integrated voice, data, and video) [ISS]
- 18.1.10 Explain network storage techniques (e.g., fiber channel, SCSI, IP, ISCSI) [ISS]

BIL: **Essential:** **ISS, NS**

EDU:	10	12	AD
ISS		I	P
NS		P	R
PSD			
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Competency 18.2: Demonstrate knowledge of local-area network trends and issues

Descriptors:

- 18.2.1 Describe the reasons for installing a network (ISS)
- 18.2.2 Trace the evolution of networks (ISS)
- 18.2.3 Analyze current trends and developments in LANs and WANs and wireless networks (ISS)

Correlated English Language Arts Academic Content Benchmarks

- *Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing).* (Reading Process B, 8-10; Reading Process B, 11-12)

BIL: **Essential:** **ISS, NS**

EDU:	10	12	AD
ISS		I	P
NS		P	R
PSD			
IM			

Competency 18.3: Demonstrate knowledge of network physical layer

Descriptors:

- 18.3.1 Differentiate between baseband and broadband transmission (ISS)
- 18.3.2 Identify the criteria used in making cable selection decisions (e.g., physical properties, transmission technologies, transmission span, bandwidth, topology, security, noise immunity, installation considerations, cost)
- 18.3.3 Differentiate between cable types (e.g., coaxial, twisted-pair, optical fibers) and interfaces (ISS)
- 18.3.4 Compare/contrast a cable types (e.g., CAT5, CAT5E, CAT6+) [ISS]
- 18.3.5 Describe types of cable connectors and grounding techniques (ISS)
- 18.3.6 Describe typical cable applications (ISS)
- 18.3.7 Identify cable standards (e.g., ANSI, EIA/TIA-568, EIA/TIA-569) [ISS]
- 18.3.8 Identify the advantages and disadvantages of cabling systems (ISS)
- 18.3.9 Describe typical problems associated with cable installation (ISS)
- 18.3.10 Demonstrate cable testing and tolerance levels
- 18.3.11 Discuss the fundamentals of RF

Correlated English Language Arts Academic Content Benchmarks

- *Use multiple resources to enhance comprehension of vocabulary.* (Vocabulary E, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)

BIL: **Essential:** **ISS, NS**

EDU:	10	12	AD
ISS		P	R
NS		P	R
PSD			
IM			

Competency 18.4: Demonstrate knowledge of network connectivity basics

Descriptors:

- 18.4.1 Identify and describe the characteristics and functions of point-to-point channels, switched, and meshed network
- 18.4.2 Define the characteristics and functions of broadcast channels
- 18.4.3 Explain types of interoperability
- 18.4.4 Describe Internet, Intranet, and Extranet usage and connectivity

Correlated English Language Arts Academic Content Benchmarks

- *Apply knowledge of roots and affixes to determine the meanings of complex words and subject area vocabulary. (Vocabulary E, 8-10)*
- *Use multiple resources to enhance comprehension of vocabulary. (Vocabulary E, 11-12)*
- *Apply knowledge of roots, affixes and phrases to aid understanding of content area vocabulary. (Vocabulary D, 11-12)*

BIL: **Essential:** **ISS, NS**
Recommended: PSD

EDU:	10	12	AD
ISS		I	P
NS		P	R
PSD			I
IM			

Competency 18.5: Demonstrate knowledge of protocol concepts

Descriptors:

- 18.5.1 Identify the advantages and disadvantages of standard protocols (ISS)
- 18.5.2 Explain the purposes of, and procedures for, encapsulation and decapsulation
- 18.5.3 Explain network protocols (e.g., IP Suite, IPX/SPX, IPSEC) [ISS]

Correlated English Language Arts Academic Content Benchmarks

- *Apply knowledge of roots, affixes and phrases to aid understanding of content area vocabulary. (Vocabulary D, 11-12)*

BIL: **Essential:** **NS**
Recommended: **ISS**

EDU:	10	12	AD
ISS		I	R
NS		P	R
PSD			
IM			

Competency 18.6: Demonstrate knowledge of the Open Systems Interconnection (OSI) standard (ISO Standard 7498)

Descriptors:

- 18.6.1 Identify the benefits of using a layered network model
- 18.6.2 Identify the seven layers at which decisions must be made according to the OSI standard
- 18.6.3 Compare OSI stack positions and their relationship to one another
- 18.6.4 Describe actions to be performed at each of the OSI physical layers

BIL: **Essential:** **NS**
Recommended: **ISS**

EDU:	10	12	AD
ISS		I	R
NS		P	R
PSD			
IM			

Competency 18.7: Demonstrate knowledge of communication standards for networks

Descriptors:

- 18.7.1 Explain digital data communication techniques and standards, including asynchronous and synchronous transmission, error detection and correction codes, and physical interfaces
- 18.7.2 Describe data-transmission basics (e.g., SYN, Syn-ack)

BIL: **Essential:** **NS**
Recommended: **ISS, PSD**

EDU:	10	12	AD
ISS		I	R
NS		I	P
PSD		I	R
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Competency 18.8: Demonstrate knowledge of data encoding basics

Descriptors:

- 18.8.1 Apply and convert amongst the four numbering systems: binary, octal, hexadecimal, and decimal (NS)

- 18.8.2 Demonstrate ASCII representation of characters (NS)
- 18.8.3 Demonstrate EBCDIC representation of characters (NS)
- 18.8.4 Convert ASCII characters to EBCDIC Unicode equivalents and vice versa (NS)

Correlated Mathematics Academic Content Benchmarks

- *Compare, order and determine equivalent forms of real numbers.* (Number E, 8-10)

BIL: **Essential:** **ISS, NS**
Recommended: **PSD**

EDU:	10	12	AD
ISS		I	P
NS		P	R
PSD			I
IM			

Competency 18.9: Demonstrate knowledge of IP addressing schemes

Descriptors:

- 18.9.1 Explain how names and addresses are determined for LANs (ISS)
- 18.9.2 Identify components of a network address in dotted decimal form (e.g., Class A, B, C) [ISS]
- 18.9.3 Identify the class of network to which a given address belongs (ISS)
- 18.9.4 Differentiate between default subnet masks and custom subnet masks (ISS)
- 18.9.5 Explain the relationship between an IP address and its associated subnet mask (ISS)
- 18.9.6 Create custom subnet masks to meet network design requirements (ISS)
- 18.9.7 Identify difference between classed and classless addressing schemes (ISS)

Correlated Mathematics Academic Content Benchmarks

- *Use a variety of mathematical representations flexibly and appropriately to organize, record and communicate mathematical ideas.* (Math. Process E, 8-10)

Unit 19: Network Architectures

BIL: **Essential:** **ISS, NS**

EDU:	10	12	AD
ISS		I	P
NS		P	R
PSD			
IM			

Competency 19.1: Demonstrate knowledge of the basics of network architecture

Descriptors:

- 19.1.1 Describe the characteristics and uses of network components (e.g., hub, switches, routers, firewall) [ISS]
- 19.1.2 Identify LAN transmission methods (e.g., bus, pure ring, star ring topologies) [ISS]
- 19.1.3 Describe broadband and baseband transmission methods and standards (ISS)
- 19.1.4 Identify LAN transmission media (e.g., twisted pair, fiber-optic cable, wireless) [ISS]
- 19.1.5 Evaluate LAN medium-access protocols (e.g., CSMA/CD, token bus, token ring, FDDI)
- 19.1.6 Identify the components of, and relationships within, the OSI 8802 (IEEE 802) protocol suite
- 19.1.7 Identify LAN performance factors (signal attenuation, signal propagation delay)
- 19.1.8 Explain reasoning for OSI modeling (ISS)
- 19.1.9 Differentiate between a physical and logical topology (e.g., VLAN) [ISS]

Correlated English Language Arts Academic Content Benchmarks

- *Distinguish the relationship of word meanings between pairs of words encountered in analogical statements.* (Vocabulary B, 11-12)
- *Apply knowledge of roots, affixes and phrases to aid understanding of content area vocabulary.* (Vocabulary D, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Solve increasingly complex non-routine measurement problems and check for reasonableness of results.* (Measurement A, 8-10)
- *Prove or disprove conjectures and solve problems involving two- and three-dimensional objects represented within a coordinate system.* (Geometry G, 8-10)
- *Solve problem situations involving derived measurements; e.g., density, acceleration.* (Measurement D, 11-12)

BIL: **Essential:** **ISS, NS**

EDU:	10	12	AD
ISS		I	P
NS		P	R
PSD			
IM			

Competency 19.2: Demonstrate knowledge of the basics of Ethernet technology

Descriptors:

- 19.2.1 Describe differences in Ethernet topologies (ISS)
- 19.2.2 Select appropriate use of basic Ethernet configurations (e.g., simple, hub, hubs and bridges, server, switch) [ISS]
- 19.2.3 Evaluate the advantages and disadvantages of Ethernet networks as they relate to other networks (ISS)

BIL: **Essential:** **ISS, NS**
Recommended: **PSD**

EDU:	10	12	AD
ISS		I	P
NS		P	R
PSD			I
IM			

Competency 19.3: Demonstrate knowledge of the TCP/IP protocol suite details

Descriptors:

- 19.3.1 Compare the basics of TCP/IP layers, components, and functions (ISS)
- 19.3.2 Identify how the TCP layers relate to the OSI model (ISS)
- 19.3.3 Compare and contrast TCP and IP delivery service (ISS)
- 19.3.4 Identify TCP/IP applications and services (e.g., rlogin, SMTP, telnet, FTP, DNS, NFS, VoIPs)
- 19.3.5 Explain TCP/IP protocol details (e.g., Internet addresses, ARP, RARP, IP datagram format, routing IP datagrams, TCP segment format)
- 19.3.6 Identify how the protocol suite can be used to provide prioritization and differentiation between multiple media types (e.g., QoS)

Unit 20: Network Operating Systems

BIL: **Essential:** **ISS, NS**

EDU:	10	12	AD
ISS		I	P
NS		P	R
PSD			
IM			

Competency 20.1: Demonstrate knowledge of the network operating systems characteristics

Descriptors:

- 20.1.1 Identify the purposes of a network operating system (NOS) [ISS]
- 20.1.2 Identify how the components of a network operating system (i.e., server platform, network services software, network redirection software, communications software) support network operations (ISS)
- 20.1.3 Define the criteria used to evaluate network operating systems (ISS)
- 20.1.4 Identify how protocols are supported
- 20.1.5 Identify licensing requirements
- 20.1.6 Describe the characteristics of the a tiered model (e.g., peer-to-peer, thin client)
- 20.1.7 Analyze the advantages and disadvantages of the client/server model (ISS)
- 20.1.8 Compare and contrast various network operating systems (e.g., Novell NetWare, Windows, Linux, UNIX) [ISS]

Correlated English Language Arts Academic Content Benchmarks

- *Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing). (Reading Process B, 11-12)*

BIL: **Essential:** **ISS, NS**

EDU:	10	12	AD
ISS		I	P
NS		I	P
PSD			
IM			

Competency 20.2: Install and administer network operating system and services

Descriptors:

- 20.2.1 Create domain trusts (NS)
- 20.2.2 Maintain domain controllers (NS)
- 20.2.3 Make policy changes (NS)
- 20.2.4 Employ policy templates (NS)
- 20.2.5 Create user accounts, groups, and login scripts (NS)
- 20.2.6 Control access to files and directories (NS, ISS)
- 20.2.7 Establish shared network resources (NS, ISS)

- 20.2.8 Configure network domain accounts and profiles (NS)
- 20.2.9 Implement system policies (NS)
- 20.2.10 Create roaming user profiles (NS)
- 20.2.11 Troubleshoot network performance (NS)

Unit 21: Wide-Area Networks

BIL: **Essential:** **ISS, NS**
Recommended: **IM**

EDU:	10	12	AD
ISS		P	R
NS		P	R
PSD			
IM		I	P

Competency 21.1: Demonstrate knowledge of basic telecommunications and the interconnection of networks

Descriptors:

- 21.1.1 Describe the different types of WAN connections
- 21.1.2 Describe point-to-point (PPP) interconnection
- 21.1.3 Identify basic telecommunications services (e.g., satellite, circuit switching, packet switching, wireless)
- 21.1.4 Identify communications carriers and their services
- 21.1.5 Identify the role of telecommunications tariffs

BIL: **Essential:** **ISS, NS**
Recommended: **IM**

EDU:	10	12	AD
ISS		I	P
NS		P	R
PSD			
IM			P

Competency 21.2: Assess user needs for a wide-area network (WAN)

Descriptors:

- 21.2.1 Determine availability from LAN to meet requirements of WAN
- 21.2.2 Determine the speed needed between sites to access applications
- 21.2.3 Determine the subnets needed on the WAN including VLSM
- 21.2.4 Evaluate transmission options

Correlated Mathematics Academic Content Benchmarks

- *Formulate a problem or mathematical model in response to a specific need or situation, determine information required to solve the problem, choose method for obtaining this information, and set limits for acceptable solution. (Math. Process A, 8-10)*

BIL: **Essential:** **ISS, NS**

EDU:	10	12	AD
ISS		I	P
NS		I	P
PSD			
IM			

Competency 21.3: Design WAN systems

Descriptors:

- 21.3.1 Describe the basics of telephony (analog vs. digital signals) [NS, ISS]
- 21.3.2 Describe the conversion of analog speech to digital (NS, ISS)
- 21.3.3 Relate voice, data concepts, and video to wide-area networks (NS)
- 21.3.4 Select primary and backup data circuits (NS)
- 21.3.5 Evaluate analog and digital transmission for cost, performance, and reliability (NS)
- 21.3.6 Integrate firewalls to separate trusted network and WAN (NS)
- 21.3.7 Establish a Virtual Private Network (VPN) to form the infrastructure of the WAN (NS)
- 21.3.8 Determine routers needed to connect with LAN (NS)
- 21.3.9 Interconnect LANs using WAN services (NS)
- 21.3.10 Demonstrate cost-savings approaches (e.g., voice/video/data compression)
- 21.3.11 Discuss complexities of routing and multiple services over a WAN (NS)

Correlated English Language Arts Academic Content Benchmarks

- *Compile, organize and evaluate information, take notes and summarize findings.* (Research B, 11-12)
- *Communicate findings, reporting on the substance and processes orally, visually and in writing or through multimedia.* (Research E, 11-12)

Unit 22: Network Management

BIL: **Essential:** **ISS, NS**
Recommended: **PSD**

EDU:	10	12	AD
ISS		I	P
NS		I	P
PSD			I
IM			

Competency 22.1: Demonstrate knowledge of network management activities and procedures

Descriptors:

- 22.1.1 Evaluate the basic principles of network management (NS, ISS)
- 22.1.2 Identify network system bootstrapping/initial program load (NS)
- 22.1.3 Identify server configuration and role (e.g., file server, print server or other network services (e.g., DNS, DHCP) [NS]
- 22.1.4 Determine file organization (e.g., by owners, users, and privileges) [NS]
- 22.1.5 Establish common standards for setting up and naming for the network, files, accounts, services (NS)
- 22.1.6 Determine methods for increasing performance (e.g., segmenting and balancing the network load, resolving channel and cable bottlenecks) [NS]
- 22.1.7 Define the role of the network manager (NS, ISS)
- 22.1.8 Determine procedures for performance analysis, evaluation, and monitoring (NS)
- 22.1.9 Determine procedures for network system optimization and tuning (NS)
- 22.1.10 Determine procedures for managing network assets (e.g., users, groups, printers) [NS]

Correlated English Language Arts Academic Content Benchmarks

- *Compile, organize and evaluate information, take notes and summarize findings.* (Research B, 11-12)
- *Evaluate the usefulness and credibility of data and sources and synthesize information from multiple sources.* (Research C, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Model and solve problem situations involving direct and inverse variation.* (Algebra I, 8-10)
- *Formulate a problem or mathematical model in response to a specific need or situation, determine information required to solve the problem, choose method for obtaining this information, and set limits for acceptable solution.* (Math. Process A, 8-10)
- *Locate and interpret mathematical information accurately, and communicate ideas, processes and solutions in a complete and easily understood manner.* (Math. Process H, 8-10)

- *Apply mathematical modeling to workplace and consumer situations, including problem formulation, identification of a mathematical model, interpretation of solution within the model, and validation to original problem situation. (Math. Process J, 11-12)*
- *Apply various measurement scales to describe phenomena and solve problems. (Measurement B, 11-12)*

BIL: **Essential:** **ISS, NS**
Recommended: **PSD**

EDU:	10	12	AD
ISS		I	P
NS		I	P
PSD			I
IM			

Competency 22.2: Demonstrate knowledge of network applications

Descriptors:

- 22.2.1 Describe how disk storage is shared across a network (NS, ISS)
- 22.2.2 Describe the differences among application-specific servers (e.g., database, print, communications, terminal, fax, security) [NS]
- 22.2.3 Identify the advantages of sharing backup and management of PCs across a network (NS, ISS)
- 22.2.4 Identify and manage software licensing requirements and categories (NS, ISS)

BIL: **Essential:** **ISS, NS**

EDU:	10	12	AD
ISS			P
NS		I	P
PSD			
IM			

Competency 22.3: Solve network applications problems

Descriptors:

- 22.3.1 Identify potential hardware compatibility problems (NS)
- 22.3.2 Identify precautions included in programs used on networks (e.g., self-metering, security keys, required configuration settings) [NS]
- 22.3.3 Identify network areas in which application problems could exist (e.g., memory allocation, file lock settings, resource availability) [NS]
- 22.3.4 Troubleshoot network software problems (NS)
- 22.3.5 Perform network analysis using monitoring tools

Correlated Mathematics Academic Content Benchmarks

- *Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions. (Number G, 8-10)*

BIL: **Essential:** **NS**
Recommended: **ISS**

EDU:	10	12	AD
ISS		I	R
NS		I	P
PSD			
IM			

Competency 22.4: Perform network analysis, selection, and design

Descriptors:

- 22.4.1 Gather data to identify customer requirements (NS)
- 22.4.2 Identify system and network requirements (NS)
- 22.4.3 Analyze requirements (NS)
- 22.4.4 Define scope of work to meet customer requirements (NS)
- 22.4.5 Develop functional requirements/specifications for high-level systems (NS)
- 22.4.6 Identify time, technology, and resource constraints (NS)
- 22.4.7 Identify physical requirements for system implementation (NS)
- 22.4.8 Analyze system interdependencies (NS)
- 22.4.9 Identify alternate solutions
- 22.4.10 Research product and vendor architecture and equipment specifications/limitations (NS)
- 22.4.11 Estimate impact of change request (NS)
- 22.4.12 Prepare cost/benefit/risk analysis
- 22.4.13 Perform human factors analysis
- 22.4.14 Participate in design reviews
- 22.4.15 Design prototype of system
- 22.4.16 Develop testing strategy
- 22.4.17 Prepare overall plan for integrating new processes, protocols, and equipment (NS)
- 22.4.18 Develop deployment strategies appropriate for situation
- 22.4.19 Analyze facilities' bandwidth requirements and capacity planning (power cable/wire conduit)
- 22.4.20 Revise processes/structure based on testing and certification (NS)
- 22.4.21 Identify hardware/software selection criteria (NS)
- 22.4.22 Select a LAN/WAN technology that meets defined set of requirements (NS)

Correlated English Language Arts Academic Content Benchmarks

- *Compile, organize and evaluate information, take notes and summarize findings.* (Research B, 11-12)
- *Communicate findings, reporting on the substance and processes orally, visually and in writing or through multimedia.* (Research E, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Write and solve real-world, multi-step problems involving money, elapsed time and temperature, and verify reasonable of solutions.* (Measurement F, 8-10)

- *Explain difference among accuracy, precision and error, and describe how each of those can affect solutions in measurement situations. (Measurement A, 11-12)*
- *Evaluate the validity of claims and predictions that are based on data by examining the appropriateness of the data collections and analysis. (Data E, 8-10)*
- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators. (Data A, 11-12)*
- *Apply mathematical knowledge and skills routinely in other content areas and practical situations. (Math. Process B, 8-10)*
- *Apply mathematical modeling to workplace and consumer situations, including problem formulation, identification of a mathematical model, interpretations of solution within the model, and validations to original problem situation. (Math. Process J, 11-12)*

BIL: **Essential:** **NS**
Recommended: **ISS**

EDU:	10	12	AD
ISS		I	R
NS		I	P
PSD			
IM			

Competency 22.5: Perform network installation procedures

Descriptors:

- 22.5.1 Access needed information using company and manufacturers' references (e.g., procedural manuals, documentation, standards, work flowcharts) [NS]
- 22.5.2 Assess user needs to determine which network operating systems to use (NS)
- 22.5.3 Set up/configure workstation-network connections (NS)
- 22.5.4 Set up/configure network components (e.g., routers, switches) [NS]
- 22.5.5 Install LAN (NS)
- 22.5.6 Configure file server in PC network (NS)
- 22.5.7 Construct network cables (NS)
- 22.5.8 Test network connectivity using a network analyzer

Correlated English Language Arts Academic Content Benchmarks

- *Compile, organize and evaluate information, take notes and summarize findings. (Research B, 11-12)*
- *Evaluate the usefulness and credibility of data and sources and synthesize information from multiple sources. (Research C, 11-12)*

BIL: **Essential:** **ISS, NS**

EDU:	10	12	AD
ISS		I	P
NS		I	P
PSD			
IM			

Competency 22.6: Perform network operation procedures

Descriptors:

- 22.6.1 Determine the type of wiring needed for the physical connection of the network (NS, ISS)
- 22.6.2 Connect PCs to form a network (NS, ISS)
- 22.6.3 Link mixed vendors (e.g., PC to Mac)
- 22.6.4 Document LAN configuration (NS, ISS)
- 22.6.5 Identify how the network protocols work together (NS)
- 22.6.6 Determine compatibility of various networks (NS)
- 22.6.7 Set up/configure TCP/IP services on workstations and network servers (NS)
- 22.6.8 Implement print queue in a network (NS)
- 22.6.9 Perform file-to-file copy in a network (NS, ISS)
- 22.6.10 Install/configure file server in a network

BIL: **Essential:** **ISS, NS**

EDU:	10	12	AD
ISS		I	P
NS		I	P
PSD			
IM			

Competency 22.7: Perform hardware and desktop support

Descriptors:

- 22.7.1 Install and use network printers (NS, ISS)
- 22.7.2 Check physical and virtual connections (NS, ISS)
- 22.7.3 Map network devices (NS)
- 22.7.4 Replace basic computer hardware (NS, ISS)
- 22.7.5 Set up system configuration (NS)
- 22.7.6 Start up/shut down network system (NS)
- 22.7.7 Install software packages (NS)
- 22.7.8 Respond to system messages (NS)
- 22.7.9 Troubleshoot system (NS)
- 22.7.10 Perform system analysis (NS)
- 22.7.11 Perform preventive maintenance (NS)
- 22.7.12 Perform software license audits
- 22.7.13 Coordinate security procedures

BIL: **Essential:** **NS**
Recommended: **ISS**

EDU:	10	12	AD
ISS		I	R
NS		I	P
PSD			
IM			

Competency 22.8: Perform network administration

Descriptors:

- 22.8.1 Define the role of the LAN administrator (NS)
- 22.8.2 Implement system security policies
- 22.8.3 Install network management software (NS)
- 22.8.4 Perform administration functions using LAN manager software
- 22.8.5 Perform bandwidth optimization
- 22.8.6 Respond to system messages (NS)
- 22.8.7 Troubleshoot system (NS)
- 22.8.8 Install and monitor server software applications
- 22.8.9 Perform system analysis (NS)
- 22.8.10 Perform preventive maintenance (NS)
- 22.8.11 Perform resource management (e.g., apply standards, address protocols, monitor network activity, perform trend analyses, functional verifications, audits and monitoring)
- 22.8.12 Coordinate security procedures
- 22.8.13 Document actions taken (e.g., backups, virus prevention, and software distribution) [NS]
- 22.8.14 Execute network diagnostics program for software and hardware (NS)
- 22.8.15 Apply standard policies
- 22.8.16 Establish a preventive maintenance schedule (NS)
- 22.8.17 Document and diagram network topology (NS)
- 22.8.18 Describe authentication process to network devices and for users (NS)

Correlated Mathematics Academic Content Benchmarks

- *Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions.* (Number G, 8-10)
- *Solve increasingly complex non-routine measurement problems and check for reasonableness of results.* (Measurement A, 8-10)

BIL: **Essential:** **NS**
Recommended: **ISS**

EDU:	10	12	AD
ISS		I	R
NS		I	P
PSD			
IM			

Competency 22.9: Perform network maintenance and diagnostics and testing

Descriptors:

- 22.9.1 Perform preventive maintenance (NS)
- 22.9.2 Respond to system messages (NS)
- 22.9.3 Troubleshoot system (NS)
- 22.9.4 Restore LAN operating systems (NS)
- 22.9.5 Replace LAN hardware components (NS)
- 22.9.6 Define the scope and applicability of the test (NS)
- 22.9.7 Develop a test plan (NS)
- 22.9.8 Identify needed resources (NS)
- 22.9.9 Obtain needed resources (NS)
- 22.9.10 Assess network impact (NS)
- 22.9.11 Set up test environment (NS)
- 22.9.12 Set up testing schedule (NS)
- 22.9.13 Execute testing in accordance with established plans and schedule (NS)
- 22.9.14 Document errors reported/tracked (NS)
- 22.9.15 Interpret test results (NS)
- 22.9.16 Develop central log strategy for network devices

BIL: **Essential:** **NS**
Recommended: **ISS**

EDU:	10	12	AD
ISS		I	R
NS		I	P
PSD			
IM			

Competency 22.10: Recommend disaster recovery and business continuity plans

Descriptors:

- 22.10.1 Differentiate between disaster recovery and business continuity
- 22.10.2 Identify common backup devices (NS)
- 22.10.3 Identify the criteria for selecting a backup system (e.g., tape) [NS]
- 22.10.4 Establish process for archiving files (NS)
- 22.10.5 Develop and test a disaster recovery plan
- 22.10.6 Develop a business resumption plan

Correlated English Language Arts Academic Content Benchmarks

- *Use multiple resources to enhance comprehension of vocabulary. (Vocabulary E, 11-12)*
- *Produce functional documents that report, organize and convey information and ideas accurately foresee readers' problems or misunderstandings and that include formatting techniques that are user friendly. (Writing Applications C, 11-12)*

Unit 23: Security Fundamentals

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS		I	P
NS		I	P
PSD		I	P
IM		P	R

Competency 23.1: Examine the history and components of information assurance

Descriptors:

- 23.1.1 Identify significant advances in the development of computer security and the trend towards information assurance (NS)
- 23.1.2 Describe the evolution of major threats to computers including physical security, viruses, worms, spyware, malware, and hacker attempts and the influence this has had on the current state of information assurance (NS, ISS, PSD)
- 23.1.3 Discuss the role of the government in evolving standards and security initiatives (e.g., encryption, cryptography) [NS]
- 23.1.4 Describe the role of networking and the increased need for security and information assurance (NS, ISS)
- 23.1.5 Discuss how legislative and ethical issues and standards have impacted network security (e.g., HIPPA, GLBA, SOX) [NS, ISS]
- 23.1.6 Discuss the need for confidentiality, integrity, and availability of information (CIA) [NS, ISS, PSD]
- 23.1.7 Discuss the need for authentication and non-repudiation of information (e.g., PKI) [NS]
- 23.1.8 Illustrate security risks and associated safeguards (NS)
- 23.1.9 Examine the role of government-industry-academia partnerships in increasing the information assurance levels domestically and globally (NS)
- 23.1.10 Discuss careers and certification programs associated with security (NS, ISS, PSD)

Correlated English Language Arts Academic Content Benchmarks

- *Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing). (Reading Process B, 11-12)*

BIL: **Essential:** **ISS, NS**
Recommended: **PSD**

EDU:	10	12	AD
ISS		I	P
NS		I	P
PSD		I	R
IM			

Competency 23.2: Describe the components associated with computer and network security systems

Descriptors:

- 23.2.1 Identify and discuss biometric systems (e.g., fingerprinting, retina scans, voice analysis) [NS]
- 23.2.2 Describe two-factor authentication techniques (e.g., smart cards) [NS, ISS]
- 23.2.3 Explain the role of digital signatures in achieving information assurance and integrity (NS)
- 23.2.4 Explain the role of digital certifications in achieving information assurance (NS)
- 23.2.5 Explain the role of hashing algorithms (e.g., MD5, SHA1) in achieving information assurance and integrity (NS)
- 23.2.6 Discuss the need for policy addressing confidentiality (NS, ISS)

Correlated English Language Arts Academic Content Benchmarks

- *Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing). (Reading Process B, 11-12)*

Unit 24: Secure Network Management

BIL: **Essential:** **NS**
Recommended: **ISS**

EDU:	10	12	AD
ISS		I	R
NS		I	P
PSD			
IM			

Competency 24.1: Implement secure network management activities and procedures

Descriptors:

- 24.1.1 Identify need for data protection (NS)
- 24.1.2 Identify need for network security ((NS)
- 24.1.3 Analyze network security issues (NS)
- 24.1.4 Identify security requirements (NS)
- 24.1.5 Analyze the advantages/disadvantages of firewall architectures
- 24.1.6 Select the appropriate security appliance (e.g., combined firewall routers, proxy server software solutions, dedicated software solutions, dedicated appliances)
- 24.1.7 Identify specific access levels that need to be accommodated
- 24.1.8 Determine how to protect against spoofing
- 24.1.9 Devise account administration functions to support network security (e.g., managing access control lists [ACL] of network resources)
- 24.1.10 Develop and establish best practices in security plans
- 24.1.11 Match security system design to identified security requirements
- 24.1.12 Analyze and discuss security issues and how they are mitigated with the use of software distribution management systems (e.g., patch management)

Correlated English Language Arts Academic Content Benchmarks

- *Produce functional documents that report, organize and convey information and ideas accurately, foresee readers' problems or misunderstandings and include formatting techniques that are user friendly. (Writing Applications C, 11-12)*

BIL: **Essential:** **NS**
Recommended: **ISS, PSD**

EDU:	10	12	AD
ISS		I	R
NS			P
PSD			I
IM			

Competency 24.2: Describe risk analysis

Descriptors:

- 24.2.1 Discuss the balance between risk, cost, security, and implementation
- 24.2.2 Discuss a variety of security architectures and their application as they pertain to business networks
- 24.2.3 Describe risks based on vulnerability level, likelihood level, and impact level to the organization

Correlated Mathematics Academic Content Benchmarks

- *Compute probabilities of compound events, independent events, and simple dependent events. (Data J, 8-10)*
- *Make predictions based on theoretical probabilities and experimental results. (Data K, 8-10)*

BIL: **Essential:** **NS**
Recommended: **ISS**

EDU:	10	12	AD
ISS		I	R
NS			P
PSD			
IM			

Competency 24.3: Explain information technology mechanisms as they apply to a multi-layer defense structure

Descriptors:

- 24.3.1 Discuss currently available intrusion prevention, detection, and mitigation systems
- 24.3.2 Illustrate auditing and log file management (e.g., archiving, clearing, sizing)
- 24.3.3 Discuss incident handling procedures, including involvement of CERT and law enforcement
- 24.3.4 Identify security risks and breaches by reviewing system logs
- 24.3.5 Discuss concepts and principles in packet inspection and filtering (e.g., firewall and routers)
- 24.3.6 Discuss concepts as they pertain to black hole lists, spam services, open relay and other types of attacks
- 24.3.7 Compare and contrast network analysis tools that identify security risks and vulnerabilities

- 24.3.8 Discuss theory of secure network management with VLANs and out-of-band networks
- 24.3.9 Discuss information asset identification and classification and disposal
- 24.3.10 Discuss concepts as they relate to human security (e.g., social engineering)

BIL: **Essential:** **ISS, NS**

EDU:	10	12	AD
ISS		I	P
NS		I	P
PSD			
IM			

Competency 24.4 Explain communication in a WAN environment

Descriptors:

- 24.4.1 Differentiate the use of tunneling protocols both hardware and software in securing communication (e.g., L2TP, PPTP) [NS]
- 24.4.2 Describe methods for encrypting communication (e.g., IPSEC) [NS]
- 24.4.3 Describe VPNs using tunneling protocols and encrypting techniques (NS, ISS)
- 24.4.4 Explain the use of enterprise authentication management in securing communications (NS)
- 24.4.5 Discuss the role of certificate authorities (NS)

Unit 25: Wireless

BIL: **Essential:** **ISS, NS, IM**
Recommended: **PSD**

EDU	10	12	AD
ISS		P	R
NS		P	R
PSD		I	P
IM		I	P

Competency 25.1: Explain wireless communications

Descriptors:

- 25.1.1 Compare and contrast various wireless protocols in common use (IM)
- 25.1.2 Compare and contrast various characteristics of wireless signals (e.g., reflection, diffraction, scattering and fading) [IM]
- 25.1.3 Differentiate medium access methods used by wireless (IM)
- 25.1.4 Describe and define other wireless communication standards in use today as they apply to personal, corporate, and public use (e.g., Bluetooth) [IM]
- 25.1.5 Describe appropriate applications of wireless technologies to specific communication scenarios (IM)

Correlated English Language Arts Academic Content Benchmarks

- *Communicate findings, reporting on the substance and processes orally, visually and in writing or through multimedia.* (Communication E, 8-10; Communication E, 11-12)

BIL: **Essential:** **NS**
Recommended: **ISS, IM**

EDU	10	12	AD
ISS			I
NS		I	P
PSD			
IM		I	P

Competency 25.2: Design and implement a wireless network solution

Descriptors:

- 25.2.1 Compare and contrast wireless solutions operating in ad hoc mode and infrastructure mode (NS)
- 25.2.2 Describe the various frequency ranges and associated rules in the wireless spectrum as managed by the Federal Communication Commission (FCC) [NS]
- 25.2.3 Define the Service Set Identifier (SSID) as used in wireless communications (NS)

- 25.2.4 Select and install access points, wireless NICs, antennas and other hardware and software components to provide a wireless networking solution as determined by a site and customer survey (NS)
- 25.2.5 Troubleshoot Wireless LANs using system logs, vendor provided utilities and diagnostic tools (NS)

BIL: **Essential:** **NS**
Recommended: **ISS, IM**

EDU:	10	12	AD
ISS			I
NS		I	P
PSD			
IM		I	P

Competency 25.3: Evaluate security concerns specific to wireless networks and devices, and techniques for minimizing those risks

Descriptors:

- 25.3.1 Define and describe the practice of “war driving” and how to mitigate this risk (NS)
- 25.3.2 Explain various methods of increasing the security of a wireless network, e.g., MAC address filtering, Wired Equivalent Privacy (WEP), Wi-Fi Protected Access (WPA), 802.1x and RADIUS) [NS]
- 25.3.3 Compare and contrast various methods, with their strengths and weaknesses, of encrypting wireless communications (NS)
- 25.3.4 Identify security enhancements provided by IEEE 802.11(x) [NS]
- 25.3.5 Define practices and policies to prevent and detect installation of unauthorized Wireless Access Points (WAPs) [NS]

Correlated English Language Arts Academic Content Benchmarks

- *Compile, organize and evaluate information, take notes and summarize findings.* (Research B, 11-12)

Unit 26: Telecommunications

BIL: **Essential:** **NS**
Recommended: **ISS**

EDU:	10	12	AD
ISS		I	R
NS		I	P
PSD			
IM			

Competency 26.1: Demonstrate knowledge of transmission line applications

Descriptors:

- 26.1.1 Define power conversion (NS)
- 26.1.2 Discuss the principles and operation of two-wire and four-wire transmission lines (NS)
- 26.1.3 Discuss the principles and operation of coaxial cable (NS)
- 26.1.4 Discuss the principles and operation of a microwave, satellite, and laser transmissions and receptions (NS)
- 26.1.5 Discuss the principles and operation of optical, analog, and digital transmissions (NS)
- 26.1.6 Compare transmission speeds of various media (NS)

Correlated English Language Arts Academic Content Benchmarks

- *Distinguish the relationship of word meanings between pairs of words encountered in analogical statements. (Vocabulary B, 11-12)*

BIL: **Essential:** **NS**
Recommended: **ISS**

EDU:	10	12	AD
ISS		I	R
NS		I	P
PSD			
IM			

Competency 26.2: Demonstrate knowledge of concepts and techniques used in working with communications systems

Descriptors:

- 26.2.1 Discuss techniques for communication media splicing and termination (NS)
- 26.2.2 Differentiate between various communications systems (NS)
- 26.2.3 Identify the characteristics and components of cabling systems (NS)
- 26.2.4 Identify bandwidth and attenuation limitations for communications systems (e.g., fiber, copper, wireless) [NS]

- 26.2.5 Identify the characteristics of various types of light sources and light detectors used in fiber optic systems (NS)
- 26.2.6 Identify the components of fiber optic transmission systems and the function of each (e.g., CWDM, DWDM) [NS]
- 26.2.7 Discuss how data signals are transformed into light pulses (NS)
- 26.2.8 Operate a simple fiber optic data transmission system
- 26.2.9 Discuss the characteristics of multi-mode and single-mode systems (NS)

BIL: **Essential:** **NS**
Recommended: **ISS**

EDU:	10	12	AD
ISS		I	R
NS		I	P
PSD			
IM			

Competency 26.3 Demonstrate knowledge of telecommunications networks

Descriptors:

- 26.3.1 Discuss the role telecommunication networks play in the contemporary business environment (NS)
- 26.3.2 Discuss how voice, data, and video inputs are converted to electromagnetic signals (NS)
- 26.3.3 Discuss advanced telecommunication broadband technologies (e.g., including frame relay and ATM, broadband, T1, T2, T3, Ethernet, IP) [NS]
- 26.3.4 Discuss the characteristics and function of ISDN and BRI , PRI signaling (NS)
- 26.3.5 Discuss mobile communications technologies, including cellular and personal communication networks (NS)
- 26.3.6 Discuss the characteristics, function and types of data compression and generational losses (NS)
- 26.3.7 Discuss the function and characteristics of DSL technologies (NS)

Correlated English Language Arts Academic Content Benchmarks

- *Use multiple resources to enhance comprehension of vocabulary.* (Vocabulary E, 11-12)
- *Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing).* (Reading Process B, 11-12)

Unit 27: Information Systems (IS) Theory

BIL: **Essential:** **ISS, NS, PSD**

EDU:	10	12	AD
ISS		I	P
NS		I	P
PSD	I	R	P
IM			

Competency 27.1: Explain systems theory

Descriptors:

- 27.1.1 Explain the underlying concepts of the information systems discipline (ISS, NS)
- 27.1.2 Compare/contrast data, information, and knowledge (ISS, NS)
- 27.1.3 Compare methods for achieving productivity in knowledge work (NS)
- 27.1.4 Apply general systems theory to the analysis and development of an information system (NS)
- 27.1.5 Identify the properties of open and proprietary systems (PSD, NS)
- 27.1.6 Define the relationship between system components (NS)
- 27.1.7 Characterize the role of data representation, both non-numeric and numeric (e.g., integers, reals, errors) [ISS, PSD, NS]
- 27.1.8 Identify procedures for formal problem solving (PSD, NS)
- 27.1.9 Differentiate between the role of information systems within a company and their role in a global environment (ISS, NS)

Correlated Mathematics Academic Content Benchmarks

- *Connect physical, verbal and symbolic representations of integers, rational numbers and irrational numbers. (Number D, 8-10)*
- *Analyze and compare functions and their graphs using attributes, such as rates of change, intercepts and zeros. (Algebra E, 8-10)*
- *Use formal mathematical language and notation to represent ideas, to demonstrate relationships within and among representation systems, and to formulate generalizations. (Math. Process H, 11-12)*

BIL: **Essential:** **ISS, NS, PSD**

EDU:	10	12	AD
ISS			P
NS			P
PSD		I	P
IM			

Competency 27.2: Define the information system infrastructure

Descriptors:

- 27.2.1 Identify systems architecture (PSD)
- 27.2.2 Identify the components of the information system infrastructure (e.g., hardware, communications, systems, site) [PSD]
- 27.2.3 Identify the relationship of users and suppliers to the information system

- 27.2.4 Identify the objectives of information system
- 27.2.5 Identify the process for selecting software products and processes
- 27.2.6 Outline the system controls (i.e., change management, service level agreement SLA)

BIL: **Essential:** **NS**
Recommended: **ISS, PSD**

EDU:	10	12	AD
ISS			I
NS			P
PSD			I
IM			

Competency 27.3: Select systems development approach

Descriptors:

- 27.3.1 Summarize application planning, development, and risk management for information system
- 27.3.2 Identify potential problems in system implementation
- 27.3.3 Determine whether prototyping system is feasible
- 27.3.4 Evaluate third-party products to include in the project implementation
- 27.3.5 Develop a plan using data-oriented techniques
- 27.3.6 Apply object-oriented development techniques
- 27.3.7 Apply process-oriented development techniques
- 27.3.8 Evaluate systems engineering considerations
- 27.3.9 Determine system design process, from specification to implementation
- 27.3.10 Appraise system process and product life-cycle models
- 27.3.11 Assess system design methods and tools

Correlated English Language Arts Academic Content Benchmarks

- *Produce functional documents that report, organize and convey information and ideas accurately, foresee readers’ problems or misunderstandings and include formatting techniques that are user friendly.* (Writing Applications C, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Evaluate the validity of claims and predictions that are based on data by examining the appropriateness of the data collections and analysis.* (Data E, 8-10)
- *Construct convincing arguments based on analysis of data and interpretations of graphs.* (Data F, 8-10)
- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators.* (Data A, 11-12)
- *Design and perform a statistical experiment, simulation or study; collect and interpret data; and use descriptive statistics to communicate and support predictions and conclusions.* (Data C, 11-12)

BIL: **Essential:** **ISS**
Recommended: **NS, PSD**

EDU:	10	12	AD
ISS			P
NS			P
PSD			I
IM			

Competency 27.4: Compare/contrast individual and collaborative knowledge work

Descriptors:

- 27.4.1 Identify stakeholders in a given IS context (i.e., key individuals)
- 27.4.2 Identify desired group and team behavior in an IS context
- 27.4.3 Describe how to apply team methods to empower coworkers
- 27.4.4 Define empowerment and effectiveness measurement
- 27.4.5 Identify knowledge-building and knowledge-maintaining tasks
- 27.4.6 Differentiate between individual and group technology
- 27.4.7 Describe the characteristics and attributes of knowledge work for both individual and group technology
- 27.4.8 Describe group support technology for common knowledge requirements
- 27.4.9 Identify work modifications necessitated by working in groups (e.g., additional processing)
- 27.4.10 Describe the information analysis process
- 27.4.11 Describe information technology solutions

Correlated English Language Arts Academic Content Benchmarks

- *Compile, organize and evaluate information, take notes and summarize findings.* (Research B, 11-12)
- *Communicate findings, reporting on the substance and processes orally, visually and in writing or through multimedia.* (Research E, 11-12)

BIL: **Essential:** **ISS**
Recommended: **NS, PSD**

EDU:	10	12	AD
ISS		I	P
NS			P
PSD			I
IM			

Competency 27.5: Evaluate strategies for implementing systems

Descriptors:

- 27.5.1 Identify requirements through interviewing of individuals and groups (ISS)
- 27.5.2 Determine information requirements through analysis of individual and group tasks
- 27.5.3 Identify information technology requirements for given worksite (ISS)

- 27.5.4 Select overall implementation strategy (e.g., top-down, bottom up; teams vs. individual)
- 27.5.5 Analyze the interaction of the operating system and hardware architecture
- 27.5.6 Establish ownership of data and system
- 27.5.7 Determine methods for providing computing support and training for the end user (ISS)
- 27.5.8 Plan measures to ensure system integrity

Correlated Mathematics Academic Content Benchmarks

- *Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)
- *Solve problem situations involving derived measurements; e.g., density, acceleration.* (Measurement D, 11-12)

BIL: **Essential:** **ISS**
Recommended: **NS, PSD**

EDU:	10	12	AD
ISS			P
NS			P
PSD			I
IM			

Competency 27.6: Measure achievement

Descriptors:

- 27.6.1 Evaluate potential systems solutions against criteria for success
- 27.6.2 Apply continuous improvement methodologies
- 27.6.3 Identify quality standards to be documented (e.g., ISO, Baldrige)
- 27.6.4 Identify the competitive advantage achieved through IS
- 27.6.5 Specify measurements to be taken
- 27.6.6 Assign responsibility for documentation

Correlated Mathematics Academic Content Benchmarks

- *Design and perform a statistical experiment, simulation or study; collect and interpret data; and use descriptive statistics to communicate and support predictions and conclusions.* (Data C, 11-12)

Unit 28: Information Systems

BIL: **Recommended: ISS, PSD**

EDU:	10	12	AD
ISS			I
NS			
PSD			I
IM			

Competency 28.1: Develop and implement organizational planning for information systems

Descriptors:

- 28.1.1 Analyze the strategic role of information systems in organizations
- 28.1.2 Identify information technology needed to support given sets of tasks and activities for individuals, workgroups, and the organization
- 28.1.3 Align IS planning with enterprise planning
- 28.1.4 Define the strategic relationship of IS activities to enhancing competitive position
- 28.1.5 Differentiate between strategic, tactical and operational level applications
- 28.1.6 Define the IS role in process re-engineering
- 28.1.7 Develop short-range IS plan
- 28.1.8 Develop continuous improvement plan
- 28.1.9 Specify functional structures (internal vs. outsourcing)
- 28.1.10 Establish goals and objectives for IS
- 28.1.11 Define mission and critical success factors

Correlated Mathematics Academic Content Benchmarks

- *Design and perform a statistical experiment, simulation or study; collect and interpret data; and use descriptive statistics to communicate and support predictions and conclusions. (Data C, 11-12)*

BIL: **Essential: ISS**
Recommended: PSD

EDU:	10	12	AD
ISS		I	P
NS			
PSD			I
IM			

Competency 28.2: Establish how information systems will be developed and managed within the organization

Descriptors:

- 28.2.1 Identify hierarchical and flow models of the organization (ISS)
- 28.2.2 Identify organizational work groups
- 28.2.3 Define the roles of professional IS personnel within the organization (ISS)

- 28.2.4 Define the function of IS management (ISS)
- 28.2.5 Identify drivers and inhibitors of information technology change in the organization
- 28.2.6 Define the role of the cognitive process in information systems design and implementation
- 28.2.7 Identify IS support for decision making (ISS)

BIL: **Essential:** **ISS**
Recommended: **PSD**

EDU:	10	12	AD
ISS			P
NS			
PSD			I
IM			

Competency 28.3: Perform IS functions

Descriptors:

- 28.3.1 Conduct EDP audits
- 28.3.2 Compare/contrast the advantages and disadvantages of various options for outsourcing IS functions
- 28.3.3 Conduct internal and external performance evaluations for IS function
- 28.3.4 Define how information and information systems will be used in documentation, decision making, and control of organizational activity
- 28.3.5 Define the relationship between systems goals and quality concepts

BIL: **Recommended: ISS, PSD**

EDU:	10	12	AD
ISS			I
NS			
PSD			I
IM			

Competency 28.4: Assess and manage IS functions

Descriptors:

- 28.4.1 Create technical and end-user telecommunication system documentation
- 28.4.2 Identify security and privacy considerations
- 28.4.3 Analyze configuration controls
- 28.4.4 Develop DBMS projects, including systems development and user documentation
- 28.4.5 Manage computer facilities
- 28.4.6 Manage group decision support systems
- 28.4.7 Justify the project management approach to be implemented
- 28.4.8 Devise techniques to enhance creative problem solving

BIL: **Recommended: PSD**

EDU:	10	12	AD
ISS			
NS			
PSD			I
IM			

Competency 28.5: Apply management principles to IS functions

Descriptors:

- 28.5.1 Identify the characteristics of principle-centered leadership
- 28.5.2 Implement a proactive approach to IS management
- 28.5.3 Devise techniques to enhance the creative design process

Unit 29: Information System Analysis and Design

BIL: **Essential:** **ISS**
Reccommended: **PSD**

EDU:	10	12	AD
ISS		I	P
NS			
PSD			I
IM			

Competency 29.1: Evaluate the role of systems analysts

Descriptors:

- 29.1.1 Identify the functions of systems analysts (ISS)
- 29.1.2 Identify the skills required for systems analysts (ISS)

BIL: **Essential:** **ISS**
Reccommended: **PSD**

EDU:	10	12	AD
ISS		I	P
NS			
PSD			I
IM			

Competency 29.2: Initiate a system project

Descriptors:

- 29.2.1 Identify the phases in a system project (ISS)
- 29.2.2 Select basic fact-gathering techniques to be used
- 29.2.3 Define the scope of the systems project
- 29.2.4 Conduct a preliminary investigation

BIL: **Essential:** **ISS**
Reccommended: **NS, PSD**

EDU:	10	12	AD
ISS			P
NS			I
PSD			I
IM			

Competency 29.3: Conduct a detailed system investigation and analysis

Descriptors:

- 29.3.1 Identify time, technology and resource constraints
- 29.3.2 Determine investigation techniques to be used
- 29.3.3 Record facts gathered through system investigation

- 29.3.4 Perform appropriate diagnostic tests
- 29.3.5 Investigate system alerts
- 29.3.6 Evaluate technical alternatives

Correlated English Language Arts Academic Content Benchmarks

- *Compile, organize and evaluate information, take notes and summarize findings.* (Research B, 11-12)

BIL: **Essential :** **ISS**
Recommended: **PSD**

EDU:	10	12	AD
ISS			P
NS			
PSD			I
IM			

Competency 29.4: Design an information system

Descriptors:

- 29.4.1 Execute the steps in system design
- 29.4.2 Design system output, system input, files, and processing
- 29.4.3 Analyze the interaction of the operating system and hardware architecture
- 29.4.4 Justify the communications selections for the system (e.g., single PCs, LANs and/or WANs)
- 29.4.5 Present system design to management

Correlated English Language Arts Academic Content Benchmarks

- *Communicate findings, reporting on the substance and processes orally, visually and in writing or through multimedia.* (Research E, 8-10)

BIL: **Essential :** **ISS**
Recommended: **PSD**

EDU:	10	12	AD
ISS			P
NS			
PSD			I
IM			

Competency 29.5: Develop the information system

Descriptors:

- 29.5.1 Execute tasks involved in system development
- 29.5.2 Identify the system components and their relationships
- 29.5.3 Specify the workflow system

- 29.5.4 Develop programming specifications
- 29.5.5 Program the system

BIL: **Essential:** **ISS**
Recommended: **PSD**

EDU:	10	12	AD
ISS			P
NS			
PSD			I
IM			

Competency 29.6: Evaluate applications within the information system

Descriptors:

- 29.6.1 Design a framework for evaluating information system functions
- 29.6.2 Compare the capabilities of an application with the requirements it is intended to meet
- 29.6.3 Identify alternative outcomes of the application verification process
- 29.6.4 Evaluate the results and the probabilities of errors in application software
- 29.6.5 Modify inputs, outputs, and processing to refine an application
- 29.6.6 Recommend new features or enhancements to existing tools

Correlated English Language Arts Academic Content Benchmarks

- *Compile, organize and evaluate information, take notes and summarize findings. (Research B, 11-12)*
- *Communicate findings, reporting on the substance and processes orally, visually and in writing, or through multimedia. (Research E, 8-10; Research E, 11-12)*

Correlated Mathematics Academic Content Benchmarks

- *Design and perform a statistical experiment, simulation or study; collect and interpret data; and use descriptive statistics to communicate and support predictions and conclusions. (Data C, 11-12)*
- *Understand the difference between a statement that is verified by mathematical proof, such as a theorem, and one that is verified empirically using examples or data. (Math. Process G, 11-12)*

BIL: **Essential:** **ISS**
Recommended: **NS, PSD**

EDU:	10	12	AD
ISS		I	P
NS			I
PSD			I
IM			

Competency 29.7: Develop IS implementation plan

Descriptors:

- 29.7.1 Analyze the effect of IS on the organizational structure (ISS)
- 29.7.2 Depict the interaction between IS and continuous improvement (ISS)
- 29.7.3 Specify the teamwork, leadership, and empowerment strategies to be used (ISS)
- 29.7.4 Specify consensus-building process to be used (ISS)
- 29.7.5 Specify the system conversion method to be used (ISS)
- 29.7.6 Document system implementation plans (ISS)

Correlated English Language Arts Academic Content Benchmarks

- *Produce functional documents that report, organize and convey information and ideas accurately, foresee readers’ problems or misunderstandings and include formatting techniques that are user friendly. (Writing Applications C, 11-12)*

BIL: **Essential:** **ISS, NS**
Recommended: **PSD**

EDU:	10	12	AD
ISS			P
NS			P
PSD			I
IM			

Competency 29.8: Perform management functions related to the planned change

Descriptors:

- 29.8.1 Schedule system change according to risk
- 29.8.2 Secure needed approvals for change
- 29.8.3 Document contingency plans
- 29.8.4 Complete a time line for the implementation of change
- 29.8.5 Perform regression tests
- 29.8.6 Document testing results
- 29.8.7 Initiate problem correction

Correlated English Language Arts Academic Content Benchmarks

- *Produce functional documents that report, organize and convey information and ideas accurately, foresee readers' problems or misunderstandings and include formatting techniques that are user friendly. (Writing Applications C, 11-12)*

Correlated Mathematics Academic Content Benchmarks

- *Construct convincing arguments based upon analysis of data and interpretation of graphs. (Data F, 8-10)*
- *Use descriptive statistics to analyze and summarize data, including measures of center, dispersion, correlation and variability. (Data B, 11-12)*
- *Locate and interpret mathematical information accurately, and communicate ideas, processes and solutions in a complete and easily understood manner. (Math. Process H, 8-10)*
- *Apply mathematical modeling to workplace and consumer situations, including problem formulations, identification of a mathematical model, interpretation of solution within the model, and validation to original problem situation. (Math. Process J, 11-12)*

Unit 30: System Installation and Maintenance

BIL: **Essential:** **ISS, NS**
Recommended: **PSD**

EDU:	10	12	AD
ISS		I	P
NS			P
PSD			I
IM			

Competency 30.1: Explain the life cycle of an information system

Descriptors:

- 30.1.1 Research the concept of information system life cycles (ISS)
- 30.1.2 Identify criteria for deciding between acquisition of software packages and custom development of software

Correlated English Language Arts Academic Content Benchmarks

- *Compile, organize and evaluate information, take notes and summarize findings.*
(Research B, 11-12)

BIL: **Essential:** **ISS, NS**
Recommended: **PSD**

EDU:	10	12	AD
ISS		I	P
NS			P
PSD			I
IM			

Competency 30.2: Implement a system

Descriptors:

- 30.2.1 Develop a detailed training, conversion, and installation plan for an information system application
- 30.2.2 Design networked solutions
- 30.2.3 Install DBMS on the server
- 30.2.4 Install appropriate operating system and telecommunications hardware and software (ISS)
- 30.2.5 Install information system application program in accordance with requirements
- 30.2.6 Evaluate processes and outcomes
- 30.2.7 Operate server applications
- 30.2.8 Operate coupled application systems
- 30.2.9 Evaluate emerging technologies and their potential effect on information system software (ISS)

Correlated English Language Arts Academic Content Benchmarks

- *Produce functional documents that report, organize and convey information and ideas accurately, foresee readers’ problems or misunderstandings and include formatting techniques that are user friendly.* (Writing Applications C, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Connect statistical techniques to applications in workplace and consumer situations.* (Data D, 11-12)

BIL: **Essential:** **ISS, NS**
Recommended: **PSD**

EDU:	10	12	AD
ISS			P
NS			P
PSD			I
IM			

Competency 30.3: Perform software configuration and installation

Descriptors:

- 30.3.1 Develop program and system specifications according to client needs
- 30.3.2 Install software with minimum disruption of process flow
- 30.3.3 Configure software appropriately for system and user application

BIL: **Essential:** **ISS, NS**
Recommended: **PSD**

EDU:	10	12	AD
ISS		I	P
NS			P
PSD			I
IM			

Competency 30.4: Monitor the information system

Descriptors:

- 30.4.1 Conduct post-implementation evaluation
- 30.4.2 Identify abnormal system performance (ISS)
- 30.4.3 Recognize security problems (ISS)
- 30.4.4 Recognize environmental problems (ISS)
- 30.4.5 Perform remote monitoring

BIL: **Essential:** **ISS, NS**

EDU:	10	12	AD
ISS		P	R
NS			P
PSD			
IM			

Competency 30.5: Perform system maintenance

Descriptors:

- 30.5.1 Demonstrate the basic elements of computer maintenance (e.g., SLAs outside vendor management)
- 30.5.2 Identify available diagnostic tools used for system maintenance
- 30.5.3 Identify maintenance procedures and processes
- 30.5.4 Assemble and disassemble computer
- 30.5.5 Establish a preventive maintenance plan
- 30.5.6 Perform maintenance and change control

BIL: **Essential:** **ISS, NS**

EDU:	10	12	AD
ISS			P
NS		I	P
PSD			
IM			

Competency 30.6: Explain backup and recovery, both on and offsite

Descriptors:

- 30.6.1 Compile backup and recovery plan to be used by technical support group and users (NS)
- 30.6.2 Discuss backup procedures in accordance with a regular schedule (NS)
- 30.6.3 Discuss recovery procedures as needed (NS)

BIL: **Essential:** **ISS, NS**

EDU:	10	12	AD
ISS		P	R
NS		I	P
PSD			
IM			

Competency 30.7: Troubleshoot problems

Descriptors:

- 30.7.1 Demonstrate basic troubleshooting procedures (NS)
- 30.7.2 Diagnose computer problems (NS)
- 30.7.3 Develop resolution plan (NS)

- 30.7.4 Test identified solutions (NS)
- 30.7.5 Implement selected solution (NS)

BIL: **Essential:** **ISS, NS**

EDU:	10	12	AD
ISS		P	R
NS		I	P
PSD			
IM			

Competency 30.8: Evaluate problem-solving processes and results

Descriptors:

- 30.8.1 Evaluate problem-solving outcomes to determine whether the problem was solved as intended (NS)
- 30.8.2 Evaluate whether the process was applied in an efficient and responsible manner (NS)
- 30.8.3 Determine needed follow-up actions (NS)

BIL: **Essential:** **ISS, NS**

EDU:	10	12	AD
ISS		P	R
NS		I	P
PSD			
IM			

Competency 30.9: Integrate software upgrades and fixes

Descriptors:

- 30.9.1 Identify principles governing software acquisition and upgrades (NS)
- 30.9.2 Analyze operational problems (NS)
- 30.9.3 Install software upgrades or patches as needed (NS)

Unit 31: System Administration and Control

BIL: **Essential:** **ISS, NS**
Recommended: **PSD**

EDU:	10	12	AD
ISS		I	P
NS			P
PSD			I
IM			

Competency 31.1: Analyze and perform general system administration tasks

Descriptors:

- 31.1.1 Facilitate the delivery of technical services (ISS)
- 31.1.2 Set up/maintain user accounts on multiple systems
- 31.1.3 Prepare cost justifications
- 31.1.4 Participate in evaluation of total system
- 31.1.5 Demonstrate basic scripting skills as they relate to systems administration and control

Correlated Mathematics Academic Content Benchmarks

- *Connect statistical techniques to applications in workplace and consumer situations. (Data D, 11-12)*
- *Apply mathematical modeling to workplace and consumer situations, including problem formulation, identification of a mathematical model, interpretations of solution within the model, and validations to original problem situation. (Math. Process J, 11-12)*

BIL: **Recommended:** **ISS**

EDU:	10	12	AD
ISS			I
NS			
PSD			
IM			

Competency 31.2: Analyze and perform advanced system administration tasks

Descriptors:

- 31.2.1 Manage inventory and assets
- 31.2.2 Analyze historical data to identify trends
- 31.2.3 Prepare documentation manuals and required reports
- 31.2.4 Analyze future technology

Correlated English Language Arts Academic Content Benchmarks

- *Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing). (Reading Process B, 8-10; Reading Process B, 11-12)*
- *Produce functional documents that report, organize and convey information and ideas accurately foresee readers' problems or misunderstandings and that include formatting techniques that are user friendly. (Writing Applications C, 11-12)*

Correlated Mathematics Academic Content Benchmarks

- *Connect statistical techniques to applications in workplace and consumer situations. (Data D, 11-12)*
- *Apply mathematical modeling to workplace and consumer situations, including problem formulation, identification of a mathematical model, interpretations of solution within the model, and validations to original problem situation. (Math. Process J, 11-12)*
- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators. (Data A, 11-12)*

BIL: **Recommended: ISS, PSD**

EDU:	10	12	AD
ISS			P
NS			
PSD			I
IM			

Competency 31.3: Develop control language programs to access system functions and database files

Descriptors:

- 31.3.1 Explain the role of control language in relation to other languages
- 31.3.2 Create, compile and test control language programs
- 31.3.3 Build forms using a layout editor
- 31.3.4 Integrate forms, reports and graphics

BIL: **Recommended: ISS, NS, PSD**

EDU:	10	12	AD
ISS			P
NS			I
PSD			I
IM			

Competency 31.4: Integrate cross platform data exchange

Descriptors:

- 31.4.1 Transfer files from a mid-range computer to a microcomputer
- 31.4.2 Transfer files from a microcomputer to a mid-range
- 31.4.3 Create Web applications to perform file transfer
- 31.4.4 Run forms and reports on the Web

BIL: **Recommended: ISS, PSD**

EDU:	10	12	AD
ISS			P
NS			
PSD			I
IM			

Competency 31.5: Store media

Descriptors:

- 31.5.1 Determine file and retrieval methods for stored media
- 31.5.2 Employ visual tool sets, languages, and libraries
- 31.5.3 Initialize/catalog media
- 31.5.4 Comply with company and/or government standards for media security
- 31.5.5 Maintain archives of company records as required by policy or law

Unit 32: Database Management System Basics

BIL: **Essential:** **ISS, PSD**
Recommended: **NS**

EDU:	10	12	AD
ISS		I	P
NS			I
PSD		I	P
IM			

Competency 32.1: Demonstrate knowledge of Database Management System (DBMS) basics

Descriptors:

- 32.1.1 Define terminology associated with relational databases (ISS, PSD)
- 32.1.2 Identify the uses of a DBMS in business organizations (ISS, PSD)
- 32.1.3 Utilize the features, functions, and architecture of a DBMS (PSD)
- 32.1.4 Analyze the organization of data in a DBMS
- 32.1.5 Use the transaction control techniques to ensure data integrity

Correlated English Language Arts Academic Content Benchmarks

- *Use multiple resources to enhance comprehension of vocabulary.* (Vocabulary E, 11-12)
- *Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing).* [Reading Process B, 11-12]

BIL: **Essential:** **ISS**
Recommended: **PSD**

EDU:	10	12	AD
ISS		I	P
NS			
PSD		I	P
IM			

Competency 32.2: Apply data structure concepts to store and retrieve data

Descriptors:

- 32.2.1 Map data model to a relational model (ISS)
- 32.2.2 Enter records into physical files (ISS)
- 32.2.3 Create and implement logical files (ISS)

BIL: **Recommended: ISS, PSD**

EDU:	10	12	AD
ISS			I
NS			
PSD			I
IM			

Competency 32.3: Design and implement stored procedures

Descriptors:

- 32.3.1 Explain procedural SQL extensions (e.g., SQL Server, Oracle)
- 32.3.2 Develop stored procedures within the DBMS
- 32.3.3 Execute and test stored procedures within the DBMS

BIL: **Essential: ISS, PSD**

EDU:	10	12	AD
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Competency 32.4: Create database query

Descriptors:

- 32.4.1 Create a query to extract information from single and multiple files (ISS, PSD)
- 32.4.2 Create nested queries (ISS)
- 32.4.3 Create reports and/or files from queries (ISS, PSD)

BIL: **Recommended: ISS, PSD**

EDU:	10	12	AD
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Competency 32.5: Employ a DBMS

Descriptors:

- 32.5.1 Distribute data across a distributed DBMS
- 32.5.2 Analyze/model organizations using Entity-Relationship and Object technologies
- 32.5.3 Identify the impact of networks on DBMS
- 32.5.4 Remove data anomalies through the process of normalization
- 32.5.5 Create/update a relational database using Structured Query Language
- 32.5.6 Query a relational database using Structured Query Language
- 32.5.7 Query data from an organizational repository using a database access facility
- 32.5.8 Perform database administration tasks

BIL: **Recommended: ISS, PSD**

EDU:	10	12	AD
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Competency 32.6: Manage implementation of a DBMS

Descriptors:

- 32.6.1 Execute implementation plan according to project time line
- 32.6.2 Implement transition plan with minimal impact on productivity
- 32.6.3 Conduct user training
- 32.6.4 Define needed external informational resources (e.g., source, content, cost, and timeliness)
- 32.6.5 Access external information resources using Internet tools
- 32.6.6 Create/maintain a directory of external information resources
- 32.6.7 Develop editors to facilitate data entry
- 32.6.8 Design simple reports for validating the performance of application systems
- 32.6.9 Apply software development principles, methods, and tools in implementing IS applications
- 32.6.10 Apply database design techniques to the implementation of a solution with calls from a program to the DBMS
- 32.6.11 Apply networking considerations in implementing distributed models
- 32.6.12 Develop server applications for installation and operation in a multi-user environment

Correlated English Language Arts Academic Content Benchmarks

- *Give presentations using a variety of delivery methods, visual displays and technology. (Communication G, 8-10; Communication F, 11-12)*
- *Give informational presentations that contain a clear perspective; present ideas from multiple sources in logical sequence; and include a consistent organizational structure. (Communication E, 11-12)*

Correlated Mathematics Academic Content Benchmarks

- *Design and perform a statistical experiment, simulation or study; collect and interpret data; and use descriptive statistics to communicate and support predictions and conclusions. (Data C, 11-12)*

BIL: **Recommended: ISS, NS, PSD**

EDU:	10	12	AD
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Competency 32.7: Monitor a DBMS

Descriptors:

- 32.7.1 Coordinate security requirements, including documentation functions
- 32.7.2 Identify desired levels of access and security
- 32.7.3 Communicate decisions concerning levels of access and security
- 32.7.4 Select monitoring tools and procedures
- 32.7.5 Identify monitoring methodologies
- 32.7.6 Identify problems in a timely fashion
- 32.7.7 Document problems
- 32.7.8 Propose solutions that are congruent with application requirements
- 32.7.9 Implement solutions to problems
- 32.7.10 Calibrate DBMS configuration parameters for optimum performance

Unit 33: Application Database Administration

BIL: **Essential:** **PSD**
Recommended: **ISS**

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Competency 33.1: Apply databases to actual situations and business problems

Descriptors:

- 33.1.1 Evaluate database design from a workflow drawing or other requirement documents (PSD)
- 33.1.2 Design a database to solve a business problem or other real-life problem situation (PSD)
- 33.1.3 Identify the relationship between database components
- 33.1.4 Sort data on multiple fields
- 33.1.5 Add/remove filters
- 33.1.6 Create queries with multiple criteria
- 33.1.7 Create/apply different types of queries
- 33.1.8 Join tables in a query
- 33.1.9 Enhance the design of a form
- 33.1.10 Create needed subforms
- 33.1.11 Group data in reports
- 33.1.12 Make a calculation on a report
- 33.1.13 Imbed data and graphics
- 33.1.14 Import data and graphics
- 33.1.15 Link data and graphics

Correlated Mathematics Academic Content Benchmarks

- *Make predictions based on theoretical probabilities and experimental results. (Data K, 8-10)*
- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators. (Data A, 11-12)*
- *Connect statistical techniques to applications in workplace and consumer situations. (Data D, 11-12)*
- *Apply mathematical modeling to workplace and consumer situations, including problem formulation, identification of a mathematical model, interpretations of solution within the model, and validations to original problem situation. (Math. Process J, 11-12)*

Correlated English Language Arts Academic Content Benchmarks

- *Apply editing strategies to eliminate slang and improve conventions.* (Writing Process D, 11-12)

BIL: **Essential:** **PSD**
Recommended: **ISS**

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Competency 33.2: Apply data modeling techniques

Descriptors:

- 33.2.1 Interpret terminology associated with data models (PSD)
- 33.2.2 Compare/contrast various data models
- 33.2.3 Analyze data models
- 33.2.4 Develop a data model to describe an application’s data

Correlated English Language Arts Academic Content Benchmarks

- *Use multiple resources to enhance comprehension of vocabulary.* (Vocabulary F, 8-10; Vocabulary E, 11-12)

BIL: **Recommended:** **ISS, PSD**

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Competency 33.3: Create conceptual data models

Descriptors:

- 33.3.1 Analyze model requirements
- 33.3.2 Identify business entities and the relationships between them
- 33.3.3 Define data in an integrated data dictionary
- 33.3.4 Ensure that conceptual model includes tools to facilitate user access

BIL: **Recommended: ISS, PSD**

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Competency 33.4: Validate conceptual data models

Descriptors:

- 33.4.1 Present conceptual data model to client
- 33.4.2 Resolve issues with client
- 33.4.3 Secure client approval for model
- 33.4.4 Feed recommendations back into the modeling process
- 33.4.5 Document validation process

Correlated English Language Arts Academic Content Benchmarks

- *Give informational presentations that present ideas in a logical sequence, include relevant facts and details from multiple sources and use a consistent organizational structure. (Communication E, 8-10; Communication E, 11-12)*
- *Give presentations using a variety of delivery methods, visual displays and technology. (Communication F, 11-12)*
- *Produce functional documents that report, organize and convey information and ideas accurately, foresee readers' problems or misunderstandings and include formatting techniques that are user friendly. (Writing Applications C, 11-12)*

Correlated Mathematics Academic Content Benchmarks

- *Use counting techniques, such as permutations and combinations, to determine the total number of options and possible outcomes. (Data H, 8-10)*

BIL: **Recommended: ISS, PSD**

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Competency 33.5: Integrate conceptual data models with enterprise models

Descriptors:

- 33.5.1 Ensure that conceptual data model is consistent with enterprise model (e.g., entity names, relationships, and definitions)
- 33.5.2 Develop conceptual schema
- 33.5.3 Secure client approval for modifications in enterprise models

BIL: **Recommended: ISS, PSD**

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Competency 33.6: Reconcile conceptual models with appropriate-level process models

Descriptors:

- 33.6.1 Verify consistencies between models
- 33.6.2 Identify areas of overlap
- 33.6.3 Verify that data entities in process model have a corresponding entity data model
- 33.6.4 Document changes or modifications in either model

Correlated Mathematics Academic Content Benchmarks

- *Translate information from one representation (words, table, graph or equation) to another representation of a relation or function. (Algebra C, 8-10)*

BIL: **Recommended: ISS, PSD**

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Competency 33.7: Create logical data models

Descriptors:

- 33.7.1 Map data model to a relational model
- 33.7.2 Identify attributes of model entities and relationships between them
- 33.7.3 Verify that logical model is consistent with conceptual model
- 33.7.4 Specify integrity constraints

Correlated Mathematics Academic Content Benchmarks

- *Translate information from one representation (words, table, graph or equation) to another representation of a relation or function. (Algebra C, 8-10)*

BIL: **Essential:** **PSD**
Recommended: **ISS**

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Competency 33.8: Identify unique identifiers (e.g., keys)

Descriptors:

- 33.8.1 Document identifiers (PSD)
- 33.8.2 Identify rationale for selection of identifiers (PSD)
- 33.8.3 Validate identifiers with client (PSD)

BIL: **Essential:** **PSD**
Recommended: **ISS**

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Competency 33.9: Normalize data models

Descriptors:

- 33.9.1 Normalize logical data model in accordance with established company policy (PSD)
- 33.9.2 Verify that data model matches specifications (PSD)
- 33.9.3 Validate logical data model with client (PSD)

BIL: **Recommended:** **ISS, PSD**

EDU:	10	12	AD
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Competency 33.10: Reconcile conceptual models with lower process models

Descriptors:

- 33.10.1 Verify consistencies between models
- 33.10.2 Identify areas of overlap
- 33.10.3 Verify that data entities in process model have a corresponding entity data model
- 33.10.4 Document changes or modifications in either model
- 33.10.5 Integrate logical data model with enterprise model

Unit 34: Database Administration

BIL: Recommended: ISS, NS, PSD

EDU:	10	12	AD
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Competency 34.1: Determine environment/platform for physical database structures and software

Descriptors:

- 34.1.1 Research potential computer environments/platforms
- 34.1.2 Identify platform capabilities and limitations
- 34.1.3 Select environment/platform based on technical, business, and skill information gathered
- 34.1.4 Secure approval of target environment/platform

Correlated English Language Arts Academic Content Benchmarks

- *Compile, organize and evaluate information, take notes and summarize findings.* (Research B, 11-12)

BIL: Essential: ISS, NS
Recommended: PSD

EDU:	10	12	AD
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Competency 34.2: Identify backup and recovery requirements for physical database

Descriptors:

- 34.2.1 Establish backup requirements consistent with corporate policy and business needs
- 34.2.2 Document established backup procedures
- 34.2.3 Control access to database to maintain security
- 34.2.4 Identify means to control access to backup

BIL: **Recommended: ISS, NS, PSD**

EDU:	10	12	AD
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Competency 34.3: Identify and integrate database access requirements

Descriptors:

- 34.3.1 Identify inputs, output, and volume of every user view
- 34.3.2 Categorize user views by type of transaction
- 34.3.3 Document access to data by type of access
- 34.3.4 Integrate access requirements with backup and recovery plan

BIL: **Recommended: ISS, PSD**

EDU:	10	12	AD
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Competency 34.4: Specify physical database characteristics

Descriptors:

- 34.4.1 Identify name, type, and length of attributes
- 34.4.2 Employ table and file names that conform to naming conventions
- 34.4.3 Group/assign tables to disk files
- 34.4.4 Index files for performance and integrity
- 34.4.5 Verify that data types are consistent between attributes
- 34.4.6 Employ normalization and modeling as cross-checking techniques

BIL: **Recommended: ISS, PSD**

EDU:	10	12	AD
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Competency 34.5: Reconcile physical design with processing requirements

Descriptors:

- 34.5.1 Resolve conflicts between physical model and process model
- 34.5.2 Verify that data entities in process model have a corresponding entity data model
- 34.5.3 Document changes made to either model

Unit 35: Data Warehousing

BIL: Recommended: ISS, NS, PSD

EDU:	10	12	AD
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Competency 35.1: Demonstrate knowledge of basic data warehousing concepts

Descriptors:

- 35.1.1 Differentiate between traditional databases and data warehouses
- 35.1.2 Recognize importance of data warehouses and integration
- 35.1.3 Recognize that information is a competitive resource
- 35.1.4 Identify components of data warehouses (e.g., subject-oriented, integrated, time-variant, nonvolatile)
- 35.1.5 Identify the characteristics and uses of metadata
- 35.1.6 Define types of information (e.g., associations, sequences, classifications, clusters, and forecasting)
- 35.1.7 Discuss data conversion techniques and functions
- 35.1.8 Identify types of programs and applications for data warehousing
- 35.1.9 Identify types of data mining tools (i.e., neural networks, decision trees, rule induction, and data visualization)
- 35.1.10 Define public summary data
- 35.1.11 Discuss ethical issues of data warehousing

Correlated English Language Arts Academic Content Benchmark

- *Use multiple resources to enhance comprehension of vocabulary.* (Vocabulary F, 8-10; Vocabulary E, 11-12)

BIL: Recommended: NS, PSD

EDU:	10	12	AD
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Competency 35.2: Apply ethical behaviors to data warehousing

Descriptors:

- 35.2.1 Define appropriate security measures
- 35.2.2 Describe the limitations of external data
- 35.2.3 Identify ethical uses of data
- 35.2.4 Define use of permanent detail data for legal or ethical purposes

BIL: **Recommended: PSD**

EDU:	10	12	AD
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Competency 35.3: Perform data entry and updating

Descriptors:

- 35.3.1 Develop an entity-relationship diagram
- 35.3.2 Employ appropriate index or indices
- 35.3.3 Define data repositories
- 35.3.4 Design metamodel
- 35.3.5 Apply appropriate security measures
- 35.3.6 Differentiate between permanent detail data and regular data
- 35.3.7 Apply skill in working with data programs
- 35.3.8 Maintain metadata
- 35.3.9 Size data warehouse
- 35.3.10 Load/transfer data (map data)
- 35.3.11 Scrub/filter data

BIL: **Recommended: PSD**

EDU:	10	12	AD
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Competency 35.4: Perform data retrieval

Descriptors:

- 35.4.1 Locate appropriate data warehouses
- 35.4.2 Perform strategic analyses using a multidimensional database
- 35.4.3 Secure necessary indices
- 35.4.4 Design reasonable query
- 35.4.5 Define nature of application
- 35.4.6 Apply appropriate security measures
- 35.4.7 Obtain necessary responses from data query
- 35.4.8 Calculate derived and aggregate data
- 35.4.9 Validate the processing of data

Correlated Mathematics Academic Content Benchmark

- *Use descriptive statistics to analyze and summarize data, including measures of center, dispersion, correlation and variability. (Data B, 11-12)*

BIL: **Recommended: PSD**

EDU:	10	12	AD
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Competency 35.5: Apply data

Descriptors:

- 35.5.1 Optimize query procedures
- 35.5.2 Evaluate information gathered in query
- 35.5.3 Utilize public summary data
- 35.5.4 Design reporting medium
- 35.5.5 Perform online analytical processing
- 35.5.6 Construct report from data gathered

Correlated English Language Arts Academic Content Benchmark

- *Produce functional documents that report, organize and convey information and ideas accurately, foresee readers' problems or misunderstandings and include formatting techniques that are user friendly. (Writing Applications C, 11-12)*

Correlated Mathematics Academic Content Benchmark

- *Use descriptive statistics to analyze and summarize data, including measures of center, dispersion, correlation and variability. (Data B, 11-12)*

Unit 36: Interactive Multimedia Production

BIL: **Essential:** **IM**
Recommended: **ISS, PSD**

EDU:	10	12	AD
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Competency 36.1: Demonstrate knowledge of interactive media

Descriptors:

- 36.1.1 Define interactive media components
- 36.1.2 Identify the major characteristics of interactive media presentations
- 36.1.3 Identify the important historical developments leading to contemporary interactive media
- 36.1.4 Identify various interactive media industry genres
- 36.1.5 Perform critical review of various interactive media end products
- 36.1.6 Identify rights, responsibilities, and controls related to various interactive media
- 36.1.7 Interpret intellectual property laws relative to interactive media
- 36.1.8 Analyze the social and cultural implications of interactive media
- 36.1.9 Identify key criticisms of interactive media
- 36.1.10 Identify possible applications for interactive media (e.g., sales and marketing, interactive advertising, K-12 education, corporate training, corporate communications, distance learning, news, entertainment)
- 36.1.11 Identify specific uses of interactive media in each potential market
- 36.1.12 Identify future trends in interactive media

Correlated English Language Arts Academic Content Benchmark

- *Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing). (Reading Process B, 11-12)*
- *Communicate findings, reporting on the substance and processes orally, visually and in writing or through multimedia. (Research E, 11-12)*

BIL: **Essential:** **IM**
Recommended: **ISS, PSD**

EDU:	10	12	AD
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Competency 36.2: Produce interactive media as a member of a development team

Descriptors:

- 36.2.1 Define the role of individual team members
- 36.2.2 Develop a conceptual model for the interactive media project
- 36.2.3 Select appropriate hardware tools
- 36.2.4 Select appropriate software tools
- 36.2.5 Select the media elements (e.g., sound, video, graphics, text, animation) to be used
- 36.2.6 Integrate media elements
- 36.2.7 Select the publication process to be used
- 36.2.8 Select the distribution method to be used
- 36.2.9 Explain decisions made (e.g., inputs and outputs)

BIL: **Essential:** **IM**
Recommended: **ISS, PSD**

EDU:	10	12	AD
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Competency 36.3: Develop project concept proposal

Descriptors:

- 36.3.1 Determine purpose of the interactive media project
- 36.3.2 Determine client needs and expected outcomes
- 36.3.3 Determine the target audience
- 36.3.4 Determine objectives
- 36.3.5 Research the content
- 36.3.6 Develop a design brief
- 36.3.7 Select appropriate message design (e.g., instructional, informational, entertainment)
- 36.3.8 Determine the setting where the message will be used
- 36.3.9 Determine the interactive media elements to be used
- 36.3.10 Determine degree of interactivity desired
- 36.3.11 Identify available media and content sources
- 36.3.12 Decide whether to produce or acquire content (graphics, animation, audio, video, simulations, virtual environments, copyrights)
- 36.3.13 Develop time line, task breakdown, and responsibilities for completion
- 36.3.14 Develop project budget
- 36.3.15 Write proposal
- 36.3.16 Obtain client approval throughout project

Correlated English Language Arts Academic Content Benchmarks

- *Formulate writing ideas, and identify a topic appropriate to the purpose and audience.* (Writing Process A, 8-10; Writing Process A, 11-12)
- *Determine the usefulness of organizers and apply appropriate pre-writing tasks.* (Writing Process B, 8-10)
- *Select and use an appropriate organizational structure to refine and develop ideas for writing.* (Writing Process B, 11-12)

- *Prepare writing for publication that is legible, follows an appropriate format and uses techniques such as electronic resources and graphics. (Writing Process F, 8-10)*
- *Produce functional documents that report, organize and convey information and ideas accurately, foresee readers' problems or misunderstandings and include formatting techniques that are user friendly. (Writing Applications C, 11-12)*

Correlated Mathematics Academic Content Benchmarks

- *Write and solve real-world, multi-step problems involving money, elapsed time and temperature, and verify reasonable of solutions. (Measurement F, 8-10)*
- *Evaluate the validity of claims and predictions that are based on data by examining the appropriateness of the data collections and analysis. (Data E, 8-10)*
- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators. (Data A, 11-12)*
- *Apply mathematical knowledge and skills routinely in other content areas and practical situations. (Math. Process B, 8-10)*
- *Apply mathematical modeling to workplace and consumer situations, including problem formulation, identification of a mathematical model, interpretations of solution within the model, and validations to original problem situation. (Math. Process J, 11-12)*

BIL: **Essential:** **IM**
Recommended: **ISS, PSD**

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Competency 36.4: Develop navigational structures

Descriptors:

- 36.4.1 Identify types of navigational menu structures (e.g., rollovers, drop-downs, disjointed) [IM]
- 36.4.2 Determine placement of navigational units (IM)
- 36.4.3 Construct and place navigational units (IM)
- 36.4.4 Developing logic/site maps (IM)

BIL: **Essential:** **IM**
Recommended: **ISS, PSD**

EDU:	10	12	AD
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Competency 36.5: Develop scripts, storyboards and flowcharts used in interactive media

Descriptors:

- 36.5.1 Determine uses and need for scripts, storyboards and flow charts
- 36.5.2 Make preliminary sketches showing placement of images and text on screen
- 36.5.3 Show placement of buttons/navigational graphics
- 36.5.4 Provide information on color schemes
- 36.5.5 Describe music to be used
- 36.5.6 Describe video (still and motion)
- 36.5.7 Describe special effects (video and audio)
- 36.5.8 Provide a sample layout

Correlated English Language Arts Academic Content Benchmark

- *Compose narratives that establish a specific setting, plot and a consistent point of view, and develop characters by using sensory details and concrete language. (Writing Applications A, 8-10)*

BIL: **Essential:** **IM**
Recommended: **ISS, PSD**

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Competency 36.6: Combine media elements to produce an interactive multimedia project

Descriptors:

- 36.6.1 Apply visual design skills (IM)
- 36.6.2 Generate text for multi-image presentations (e.g., title graphics, charts, graphs) [IM]
- 36.6.3 Create 2-D computer graphics (IM)
- 36.6.4 Create 3-D computer graphics (IM)
- 36.6.5 Create computer animation (IM)
- 36.6.6 Prepare photographic images for interactive media
- 36.6.7 Alter images using an image manipulation program
- 36.6.8 Integrate photographically derived images with hand-drawn graphic images
- 36.6.9 Integrate the use of photographic special effects into interactive media presentations

- 36.6.10 Acquire talent, if necessary
- 36.6.11 Coordinate work with the acquired talent
- 36.6.12 Create/acquire video footage
- 36.6.13 Digitize/edit video footage using computer video-editing software
- 36.6.14 Record/acquire sound track, including narration, voice-overs, sound effects, and music
- 36.6.15 Integrate sound with visuals
- 36.6.16 Build in hotspots and interactive links
- 36.6.17 Synthesize available interactive media technologies into a unified presentation/product using software and hardware tools
- 36.6.18 Test product
- 36.6.19 Debug product
- 36.6.20 Maintain/update product

Correlated English Language Arts Academic Content Benchmarks

- *Give informational presentations that present ideas in a logical sequence, include relevant facts and details from multiple sources and use a consistent organizational structure.* (Communication E, 8-10)
- *Give presentations using a variety of delivery methods, visual displays and technology.* (Communication G, 8-10; Communication F, 11-12)
- *Give informational presentations that contain a clear perspective; present ideas from multiple sources in logical sequence; and include a consistent organizational structure.* (Communication E, 11-12)

BIL: **Essential:** **IM**
Recommended: ISS, PSD

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Competency 36.7: Explain the types and uses of interactive media applications

Descriptors:

- 36.7.1 Describe an interactive media presentation (e.g., Web-based, local)
- 36.7.2 Define *kiosks* and their uses
- 36.7.3 Define video conferences and their uses
- 36.7.4 Identify the characteristics of gaming and simulations
- 36.7.5 Analyze interactive communities (e.g., gaming, interpersonal, auctions, support groups) and their functions in society
- 36.7.6 Define mobile applications and their uses
- 36.7.7 Identify emerging applications and their uses

Correlated English Language Arts Academic Content Benchmark

- *Use multiple sources to enhance comprehension of vocabulary.* (Vocabulary F, 8-10; Vocabulary E, 11-12)

BIL: **Essential:** **ISS, IM**

EDU:	10	12	AD
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Competency 36.8: Demonstrate knowledge of developing a training product

Descriptors:

- 36.8.1 Differentiate between training needs and development needs (ISS)
 36.8.2 Identify the major characteristics of learner audiences (adults, adolescents, etc.) [ISS]
 36.8.3 Identify methods of product delivery (e.g., Internet, CD-ROM, Audio/Video) [ISS]

BIL: **Essential:** **IM**
Recommended: **ISS**

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Competency 36.9: Develop a training product

Descriptors:

- 36.9.1 Analyze the audience (IM)
 36.9.2 Identify learner needs (IM)
 36.9.3 Develop training objectives (IM)
 36.9.4 Employ sound instructional design principles (IM)
 36.9.5 Employ a variety of media in presenting training (IM)
 36.9.6 Evaluate training effectiveness (IM)

Correlated English Language Arts Academic Content Benchmarks

- *Formulate writing ideas, and identify a topic appropriate to the purpose and audience.* (Writing Process A, 8-10; Writing Process A, 11-12)
- *Evaluate the content and purpose of a presentation by analyzing the language and delivery choices made by a speaker.* (Communication C, 8-10)
- *Evaluate the clarity, quality, effectiveness and overall coherence of a speaker's key points, arguments, evidence, organization of ideas, delivery, diction and syntax.* (Communication B, 11-12)

- Give presentations using a variety of delivery methods, visual displays and technology. (Communication G, 8-10; Communication G, 11-12)
- Give informational presentations that present ideas in a logical sequence, include relevant facts and details from multiple sources and use a consistent organizational structure. (Communications E, 8-10)

BIL: **Recommended: ISS, IM**

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Competency 36.10: Maintain interactive media equipment

Descriptors:

- 36.10.1 Demonstrate proper care and handling procedures for interactive media equipment
- 36.10.2 Perform pre-and post-production routines for presentations
- 36.10.3 Analyze equipment performance against industry standards
- 36.10.4 Troubleshoot simple equipment problems

BIL: **Essential: IM**
Recommended: ISS

EDU:	10	12	AD
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Competency 36.11: Assess interactive media career opportunities

Descriptors:

- 36.11.1 Identify potential career areas in interactive media
- 36.11.2 Identify education/training needs (e.g., degree, non-degree, certificates, and certification)
- 36.11.3 Initiate portfolio

Correlated English Language Arts Academic Content Benchmarks

- Apply tools to judge the quality of writing. (Writing Process E, 8-10)
- Prepare writing for publication that is legible, follows an appropriate format and uses techniques such as electronic resources and graphics. (Writing Process F, 8-10)
- Give presentations using a variety of delivery methods, visual displays and technology. (Communications G, 8-10; Communication F, 11-12)

Unit 37: Appreciation of the Arts

BIL: **Essential:** **IM**
Recommended: **ISS**

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Competency 37.1: Demonstrate knowledge of and an appreciation for music

Descriptors:

- 37.1.1 Compare/contrast the role of music in different historical periods (IM)
- 37.1.2 Assess the role of music in contemporary living (IM)
- 37.1.3 Compare/contrast the function of music in different cultures (IM)
- 37.1.4 Distinguish the basic physical properties of sound (e.g., pitch, intensity, duration, and timbre) [IM]
- 37.1.5 Distinguish the various elements of music (e.g., rhythm, melody, harmony, tone, color, and form) [IM]
- 37.1.6 Identify how musical elements relate to the meaning or content of a composition (IM)
- 37.1.7 Identify the feelings conveyed by various musical elements (e.g., thematic construction, tonal color, instruments, texture, volume, and tempo) [IM]
- 37.1.8 Discuss how music visualization is used to evoke a specific emotional response (IM)

Correlated English Language Arts Academic Content Benchmarks

- *Produce functional documents that report, organize and convey information and ideas accurately, foresee readers' problems or misunderstandings and include formatting techniques that are user friendly. (Writing Applications C, 11-12)*
- *Produce informational essays or reports that establish a clear and distinctive perspective on the subject, include relevant perspectives, take into account the validity and reliability of sources and provide a clear sense of closure. (Writing Applications D, 11-12)*

BIL: **Essential:** **IM**
Recommended: **ISS**

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Competency 37.2: Demonstrate knowledge of and an appreciation for the visual arts

Descriptors:

- 37.2.1 Compare/contrast the visual art styles of various historical periods (IM)

- 37.2.2 Define various forms of visual art (IM)
- 37.2.3 Define the various elements of visual arts (e.g., lines, colors, light and dark, texture, volume, perspective) [IM]
- 37.2.4 Identify the feelings conveyed by various elements of visual arts (IM)
- 37.2.5 Discuss how music and visuals can evoke a specific emotional response (IM)

Correlated English Language Arts Academic Content Benchmarks

- *Produce functional documents that report, organize and convey information and ideas accurately, foresee readers’ problems or misunderstandings and include formatting techniques that are user friendly* (Writing Applications C, 11-12)
- *Produce informational essays or reports that establish a clear and distinctive perspective on the subject, include relevant perspectives, take into account the validity and reliability of sources and provide a clear sense of closure.* (Writing Applications D, 11-12)

BIL: **Essential:** **IM**
Recommended: **ISS**

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Competency 37.3: Demonstrate knowledge of and an appreciation for literature

Descriptors:

- 37.3.1 Compare/contrast the role of literature in different historical periods
- 37.3.2 Assess the role of literature in contemporary living
- 37.3.3 Compare/contrast the function of literature in different cultures
- 37.3.4 Discuss the impact of literature on the business environment
- 37.3.5 Discuss the basic themes used in literature
- 37.3.6 Discuss the basic styles/genres of literature
- 37.3.7 Identify the basic elements of a story (e.g., plot, characters, and setting)
- 37.3.8 Analyze the themes and styles used in interactive stories

Correlated English Language Arts Academic Content Benchmarks

- *Identify similar recurring themes across different works.* (Reading: Literary Text D, 8-10)
- *Analyze the use of a genre to express a theme or topic.* (Reading: Literary Text E, 8-10)
- *Explain techniques used by authors to develop style.* (Reading: Literary Text G, 8-10)
- *Explain ways characters confront similar situations and conflict.* (Reading: Literary Text B, 11-12)
- *Recognize and analyze characteristics of subgenres and literary periods.* (Reading: Literary Text C, 11-12)

- *Analyze and evaluate the five elements (e.g., plot, character, setting, point of view and theme) in literary text.* (Reading: Literary Text A, 11-12)
- *Critique an author's style.* (Reading: Literary Text E, 11-12)

Unit 38: Graphic Design Fundamentals

BIL: **Essential:** **IM**
Recommended: **ISS**

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Competency 38.1: Demonstrate basic knowledge of technical art skills (traditional and electronic)

Descriptors:

- 38.1.1 Demonstrate the ability to center, space, and scale drawings
- 38.1.2 Identify various types of drawing media and a variety of surfaces
- 38.1.3 Identify various examples of mechanical drawing equipment
- 38.1.4 Interpret information from drawings, prints, and sketches
- 38.1.5 Draw freehand sketches
- 38.1.6 Alter drawings
- 38.1.7 Create charts, graphs, and diagrams
- 38.1.8 Evaluate drawings

Correlated English Language Arts Academic Content Benchmarks

- *Analyze whether graphics supplement textual information and promote the author's purpose.* (Reading: Informational Text C, 8-10)
- *Use multiple resources to enhance comprehension of vocabulary.* (Vocabulary E, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Describe and apply properties of similar and congruent figures, and justify conjectures involving similarity and congruence.* (Geometry B, 8-10)
- *Represent transformations within a coordinate system using vectors and matrices.* (Geometry B, 11-12)
- *Create, interpret and use graphical displays and statistical measures to describe data; e.g., box-and-whisker plots, histograms, scatterplots, measures of center and variability.* (Data A, 8-10)
- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators.* (Data A, 11-12)
- *Formally define geometric figures.* (Geometry A, 8-10)

BIL: **Essential:** **PSD, IM**
Recommended: **ISS**

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Competency 38.2: Demonstrate knowledge of design principles

Descriptors:

- 38.2.1 Apply the principles of basic composition picture plan (PSD)
- 38.2.2 Apply the principles and elements of design and their relationship to each other
- 38.2.3 Identify the nature of color and color harmonies
- 38.2.4 Assess the impact of various color harmonies on basic composition
- 38.2.5 Assess how color affects the principles of line, value, shape and form

Correlated English Language Arts Academic Content Benchmarks

- *Use multiple resources to enhance comprehension of vocabulary.* (Vocabulary E, 11-12)

BIL: **Essential:** **IM**
Recommended: **ISS, PSD**

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Competency 38.3: Demonstrate design skills

Descriptors:

- 38.3.1 Apply elements of design (e.g., line, shape, color)
- 38.3.2 Apply principles of design (e.g., proportion, balance, harmony, rhythm, unity)
- 38.3.3 Apply color theory
- 38.3.4 Develop thumbnail concepts
- 38.3.5 Develop rough and comprehensive layouts
- 38.3.6 Create symmetric and asymmetric designs
- 38.3.7 Make collages
- 38.3.8 Describe digital color concepts

Correlated Mathematics Academic Content Benchmarks

- *Identify subsets of the real number system.* (Number B, 8-10)
- *Connect physical, verbal and symbolic representations of integers, rational numbers and irrational numbers.* (Number D, 8-10)

BIL: **Essential :** **IM**
Recommended: **ISS, PSD**

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Competency 38.4: Demonstrate knowledge of available graphics software applications

Descriptors:

- 38.4.1 Apply tones, hues, and values
- 38.4.2 Apply color for emotional impact
- 38.4.3 Contrast/compare vector and raster images
- 38.4.4 Identify industry accepted graphic file types (e.g., .jpg, .gif, tif, .eps, .pdf)
- 38.4.5 Compare/contrast different types of graphics applications (e.g., vector, raster, image)
- 38.4.6 Identify graphic tools, menus, and functions, such as grouping, transformations and blending
- 38.4.7 Identify simple and advanced development tools, styles, templates, and automated tasks
- 38.4.8 Identify simple and advanced techniques for manipulating object attributes and types
- 38.4.9 Select the most effective graphics applications for the intended uses

BIL: **Essential :** **IM**
Recommended: **ISS, PSD**

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Competency 38.5: Construct digital graphics

Descriptors:

- 38.5.1 Identify audience and purpose of graphics
- 38.5.2 Select the appropriate style of graphics based on the intended purpose
- 38.5.3 Create graphics that integrate principles of communication and elements of visual design

Correlated English Language Arts Academic Content Benchmarks

- *Analyze whether graphics supplement textual information and promote the author’s purpose.* (Reading: Informational Text C, 8-10)

BIL: **Essential :** **IM**
Recommended: **ISS, PSD**

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Competency 38.6: Manipulate digital graphics

Descriptors:

- 38.6.1 Manipulate color, shape, size, and textures of graphics
- 38.6.2 Import objects from other applications
- 38.6.3 Export objects to other applications
- 38.6.4 Rotate graphics
- 38.6.5 Rotate text
- 38.6.6 Paint/touch up images
- 38.6.7 Add/subtract image parts
- 38.6.8 Apply 2-D and 3-D graphics principles
- 38.6.9 Manipulate multiple image layers
- 38.6.10 Employ masking techniques
- 38.6.11 Crop images
- 38.6.12 Determine appropriate uses of halftone, duotone, and multi-color processes
- 38.6.13 Scale images
- 38.6.14 Employ various filtration methods
- 38.6.15 Convert raster to vector images
- 38.6.16 Store images in appropriate formats and resolutions for specific applications
- 38.6.17 Save/retrieve graphics
- 38.6.18 Print graphics to various output devices (e.g., file, monitor, pdf)

Correlated Mathematics Academic Content Benchmarks

- *Use proportional reasoning and apply indirect measurement techniques, including right triangle trigonometry and properties of similar triangle, to solve problems involving measurements and rates. (Measurement D, 8-10)*
- *Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision. (Measurement E, 8-10)*
- *Use coordinate geometry to represent and examine the properties of geometric figures. (Geometry D, 8-10)*
- *Draw and construct representations of two-and three-dimensional geometric objects using a variety of tools, such as straightedge, compass and technology. (Geometry E, 8-10)*
- *Represent and model transformations in a coordinate plane and describe the results. (Geometry F, 8-10)*

BIL: **Essential:** **IM**
Recommended: **ISS**

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Competency 38.7: Integrate knowledge of typography

Descriptors:

- 38.7.1 Interpret typographic terms (e.g., serif, sans-serif, picas, points)
- 38.7.2 Identify typographic styles
- 38.7.3 Define basic letter structures
- 38.7.4 Mix families of type within a project
- 38.7.5 Select proper letter and line spacing
- 38.7.6 Select appropriate typefaces
- 38.7.7 Prepare type formats (e.g., style guides)

Correlated English Language Arts Academic Content Benchmarks

- *Use multiple resources to enhance comprehension of vocabulary.* (Vocabulary E, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions.* (Number G, 8-10)

Unit 39: Photography

BIL: **Essential:** **IM**
Recommended: **ISS**

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Competency 39.1: Develop competency in the use of photographic equipment

Descriptors:

- 39.1.1 Differentiate between various formats (i.e., traditional vs. digital) [IM]
- 39.1.2 Select appropriate camera format for given situation (IM)
- 39.1.3 Demonstrate knowledge of apertures (IM)
- 39.1.4 Identify appropriate depth of field (IM)
- 39.1.5 Employ appropriate shutter speeds (IM)
- 39.1.6 Employ appropriate shutter speed for desired exposure effects (IM)
- 39.1.7 Use shutter speed to stop and show motion (IM)
- 39.1.8 Calculate equivalent exposures (IM)
- 39.1.9 Identify desired exposure using a light meter (IM)
- 39.1.10 Provide needed lighting conditions using electronic flash units (IM)
- 39.1.11 Create photographs using varied lighting and formats (IM)
- 39.1.12 Create photographs using different lenses (e.g., wide-angle, telephoto, zoom) [IM]
- 39.1.13 Identify appropriate light sources (IM)
- 39.1.14 Create photographs using various lens filters (e.g., color-compensating, polarizing, special effects, black-and-white contrast control) [IM]

Correlated Mathematics Academic Content Benchmarks

- *Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions.* (Number G, 8-10)
- *Find the square root of perfect squares, and approximate the square root of non-perfect squares.* (Number H, 8-10)

BIL: **Essential:** **IM**
Recommended: **ISS**

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Competency 39.2: Demonstrate knowledge of photographic terminology

Descriptors:

- 39.2.1 Discuss the role played by the following photographic elements: composition, formal qualities, scale, use of space, use of light (IM)
- 39.2.2 Discuss how the meaning of a photograph is affected by composition, formal qualities, scale, use of space, and use of light (IM)
- 39.2.3 Identify the use and meaning of symbolism in given photographs (IM)
- 39.2.4 Identify the use and meaning of metaphor in given photographs (IM)

Correlated English Language Arts Academic Content Benchmarks

- *Use context clues and text structures to determine the meaning of new vocabulary.* (Vocabulary A, 8-10)
- *Recognize the importance and function of figurative language.* (Vocabulary C, 8-10)
- *Use multiple resources to enhance comprehension of vocabulary.* (Vocabulary E, 11-12)

Unit 40: Visual Media Design

BIL: **Essential:** **IM**
Recommended: **ISS, PSD**

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Competency 40.1: Create visual design guidelines

Descriptors:

- 40.1.1 Integrate paint, illustration, and imaging manipulation techniques with digital images (IM)
- 40.1.2 Consider the visual characteristics of various media (e.g., video, print, Web) [IM]
- 40.1.3 Assess how the technical limitations of the medium affect content and style (IM)
- 40.1.4 Consider the relationship between form and content (IM)
- 40.1.5 Plan a visual design utilizing the form follows function principle (IM)
- 40.1.6 Create a multi-layered image (IM)
- 40.1.7 Select appropriate colors for the design (IM)
- 40.1.8 Define color editing capabilities (IM)
- 40.1.9 Identify appropriateness of 3-D elements
- 40.1.10 Integrate human factors and user interface in visual design (IM)
- 40.1.11 Evaluate visual appeal of design (IM)
- 40.1.12 Construct model (i.e., physical or computer-based) [IM]
- 40.1.13 Evaluate model against guidelines (IM)

BIL: **Essential:** **IM**
Recommended: **ISS, PSD**

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Competency 40.2: Demonstrate proficiency in the use of digital imaging techniques and equipment

Descriptors:

- 40.2.1 Identify standard hardware platform components and configurations (e.g., UNIX, Windows, Macintosh) [IM]
- 40.2.2 Identify memory and storage requirements (IM)
- 40.2.3 Identify computer architecture requirements for digital imaging (IM)
- 40.2.4 Explain how a digital image is generated (IM)
- 40.2.5 Identify types of digital imaging software (IM)
- 40.2.6 Compare performance of different types of image acquisition hardware (IM)

- 40.2.7 Operate digital imaging equipment (e.g., scanner, digital camera, video input devices, graphics tablet, graphics expansion board, printer, film recorder, and output devices) [IM]
- 40.2.8 Compare/contrast area and linear arrays (IM)
- 40.2.9 Compare/contrast exposure and multiexposure systems (IM)
- 40.2.10 Compare/contrast layering techniques (IM)
- 40.2.11 Select appropriate resolution (IM)
- 40.2.12 Perform resolution calculations (e.g., number of pixels, number of colors) [IM]
- 40.2.13 Compare/contrast addressable and displayable resolution (IM)
- 40.2.14 Archive and manage images (IM)

Correlated Mathematics Academic Content Benchmarks

- *Draw and construct representations of two- and three-dimensional geometric object using a variety of tools, such as straightedge, compass and technology.* (Geometry E, 8-10)
- *Represent transformations within a coordinate system using vectors and matrices.* (Geometry B, 11-12)
- *Compare, order and determine equivalent forms of real numbers.* (Number E, 8-10)

BIL: **Essential:** **IM**
Recommended: **ISS**

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Competency 40.3: Demonstrate knowledge of the basic principles of 3-D modeling

Descriptors:

- 40.3.1 Explain how to convert objects from two-dimensional to three-dimensional
- 40.3.2 Explain how a computer deals with geometry (e.g., algorithms, vectors)
- 40.3.3 Identify the software available for 3-D modeling
- 40.3.4 Explain the steps for building a 3-D model
- 40.3.5 Define the components of a wireframe model

Correlated Mathematics Academic Content Benchmarks

- *Prove or disprove conjectures and solve problems involving two- and three-dimensional objects represented with a coordinate system.* (Geometry G, 8-10)
- *Represent transformations within a coordinate system using vectors and matrices.* (Geometry B, 11-12)

BIL: **Recommended: ISS, IM**

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Competency 40.4: Create 3-D models

Descriptors:

- 40.4.1 Create a model using 3-D modeling software
- 40.4.2 Determine desired camera angle
- 40.4.3 Adjust lighting angle, focus, and color to achieve desired effect
- 40.4.4 Adjust surface color, texture, transparency, and reflectivity to achieve desired effect
- 40.4.5 Compare/contrast flat shading, curved shading, ray tracing, and radiosity methods
- 40.4.6 Render the object using flat shading
- 40.4.7 Render the object using curved shading
- 40.4.8 Render the object using ray tracing
- 40.4.9 Combine models to create a scene
- 40.4.10 Render the completed scene

Correlated Mathematics Academic Content Benchmarks

- *Recognize and apply angle relationships in situations involving intersecting lines, perpendicular lines and parallel lines. (Geometry C, 8-10)*
- *Represent and model transformations in a coordinate plane and describe the results. (Geometry F, 8-10)*

BIL: **Essential: IM**
Recommended: ISS

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Competency 40.5: Perform advanced 3-D image generation techniques

Descriptors:

- 40.5.1 Follow basic animation principles
- 40.5.2 Perform basic texture-mapping algorithms
- 40.5.3 Perform basic antialiasing
- 40.5.4 Perform basic volume-rendering algorithms
- 40.5.5 Develop basic curves and surfaces
- 40.5.6 Perform surface detail modeling

BIL: **Essential:** **IM**
Recommended: **ISS**

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Competency 40.6: Utilize the basic principles of 2-D animation

Descriptors:

- 40.7.1 Explain the principles of continuity, key frames, motion paths, and motion (e.g., shape tweening, path tweening, motion tweening)
- 40.7.2 Create special effects and virtual navigation
- 40.7.3 Identify available animation software programs/tools
- 40.7.4 Create 2-D sprite animation
- 40.7.5 Discuss the principles of cell animation
- 40.7.6 Explain timelines, key frames, and objects in animation

Correlated English Language Arts Academic Content Benchmarks

- *Use multiple resources to enhance comprehension of vocabulary.* (Vocabulary E, 11-12)

BIL: **Essential:** **IM**
Recommended: **ISS**

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Competency 40.7: Utilize the basic principles of 3-D animation

Descriptors:

- 40.7.1 Create pre-rendered 3-D animation (IM)
- 40.7.2 Create real-time Virtual Reality Mark-up Language (VRML) 3-D animation

BIL: **Recommended:** **ISS, IM**

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Competency 40.8: Develop animated characters

Descriptors:

- 40.8.1 Design a character based on a narrative context
- 40.8.2 Develop characters in accordance with designs
- 40.8.3 Animate a character so as to express its nature

- 40.8.4 Capture motion
- 40.8.5 Design 2-D characters
- 40.8.6 Design 3-D models of characters

Correlated Mathematics Academic Content Benchmarks

- *Draw and construct representations of two- and three-dimensional geometric objects using a variety of tools, such as straightedge, compass and technology.* (Geometry E, 8-10)
- *Represent transformations with a coordinate system using vectors and matrices.* (Geometry B, 11-12)

BIL: **Recommended: ISS, IM**

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Competency 40.9: Create 3-D environments

Descriptors:

- 40.9.1 Create buildings and rooms
- 40.9.2 Import buildings and rooms
- 40.9.3 Create land forms
- 40.9.4 Import land forms
- 40.9.5 Create bodies of water (e.g., lakes, rivers, oceans, waterfalls)
- 40.9.6 Create basic water textures, reflections, refractions, and splashing
- 40.9.7 Incorporate fog and background images
- 40.9.8 Manipulate particle systems such as rain and snow
- 40.9.9 Apply lighting effects
- 40.9.10 Add special effects
- 40.9.11 Code object intelligence into a 3-D environment

BIL: **Recommended: ISS, IM**

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Competency 40.10: Demonstrate knowledge of virtual environment

Descriptors:

- 40.10.1 Explain the basic principles of virtual environment
- 40.10.2 Explain the principles of geometry relative to virtual environment
- 40.10.3 Differentiate virtual environment file formats (e.g., QTVR, IPIX)
- 40.10.4 Manage polygon resources
- 40.10.5 Create a basic virtual environment

Unit 41: Video Production

BIL: **Essential:** **IM**
Recommended: **ISS**

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Competency 41.1: Identify technical support tasks of video production

Descriptors:

- 41.1.1 Identify steps needed to acquire talent
- 41.1.2 Identify needed equipment and props
- 41.1.3 Identify potential locations for shooting
- 41.1.4 Identify scheduling needs
- 41.1.5 Identify editing needs
- 41.1.6 Describe music to be used
- 41.1.7 Describe video (still and motion)
- 41.1.8 Describe special effects (video and audio)
- 41.1.9 Describe scenes
- 41.1.10 Identify tasks required to price production needs

BIL: **Essential:** **IM**
Recommended: **ISS**

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Competency 41.2: Interpret the relationship between the creative and craft skills required for video production

Descriptors:

- 41.2.1 Identify the working relationships that exist between the various participants involved in the video production process
- 41.2.2 Discuss the relationship of the specific technical processes used by the camera, grip, lighting, sound, art, costume, special effects, make up, and editing departments
- 41.2.3 Analyze a script to identify technical requirements
- 41.2.4 Compare/contrast the techniques used in film and video production in studio and field

BIL: **Essential:** **IM**
Recommended: **ISS**

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Competency 41.3: Perform camera-related tasks for a video production

Descriptors:

- 41.3.1 Analyze the aesthetic needs of a shot and accomplish them (IM)
- 41.3.2 Organize the proper care and handling of camera and camera assist equipment (IM)
- 41.3.3 Analyze the script for camera lens and shot requirements (IM)
- 41.3.4 Organize pre and post-production routines for camera operation (IM)
- 41.3.5 Analyze production requirements to determine camera equipment needs (IM)

BIL: **Essential:** **IM**
Recommended: **ISS**

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Competency 41.4: Perform lighting activities for a video production

Descriptors:

- 41.4.1 Identify different types of lighting fixtures (IM)
- 41.4.2 Identify parts of lighting fixtures and the function of each (IM)
- 41.4.3 Identify various applications of stage lighting equipment (IM)
- 41.4.4 Describe functions of master lighting panel and dimmer board (IM)
- 41.4.5 Analyze/document lighting requirements for production (IM)
- 41.4.6 Design a standard lighting plot (IM)
- 41.4.7 Set up appropriate lighting for a production (IM)
- 41.4.8 Operate master lighting panel and dimmer board in accordance with specifications
- 41.4.9 Appraise maintenance needs for lighting equipment (IM)
- 41.4.10 Design special effects lighting (IM)

BIL: **Essential:** **IM**
Recommended: **ISS**

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Competency 41.5: Design scenery for a video production

Descriptors:

- 41.5.1 Design scenic plans to scale (IM)
- 41.5.2 Interpret scenic plans to determine the materials and hardware needed for scenic construction (IM)
- 41.5.3 Formulate design strategies for the construction of scenery (IM)
- 41.5.4 Create special effects scenery (IM)
- 41.5.5 Select stage props (IM)
- 41.5.6 Organize transportation of scenery to remote locations
- 41.5.7 Inspect/repair scenery as needed

BIL: **Essential:** **IM**
Recommended: **ISS**

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Competency 41.6: Operate video cameras/camcorders

Descriptors:

- 41.6.1 Set white balance for different lighting conditions (e.g., tungsten, daylight, backlight)
- 41.6.2 Practice camera movements (e.g., panning, zooming, tilting) using a tripod and handheld camera
- 41.6.3 Practice manual iris and focus
- 41.6.4 Playback recording on monitor
- 41.6.5 Identify the effect on a video camera of changing the setting in low light levels
- 41.6.6 Describe how a camera converts light to an electronic signal (e.g., CCD, CMOS, single vs. multi-chip, optics, A-D converter)

BIL: **Essential:** **IM**
Recommended: **ISS**

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Competency 41.7: Perform technical support tasks for a video production

Descriptors:

- 41.7.1 Formulate strategies to properly utilize grip equipment during video production (IM)
- 41.7.2 Create solutions to unique shooting problems (IM)
- 41.7.3 Organize pre- and post-production routines (IM)
- 41.7.4 Analyze production requirements to determine grip equipment needs
- 41.7.5 Create required effects for lighting set-ups (IM)
- 41.7.6 Demonstrate safe work habits (IM)
- 41.7.7 Work as a member of a video production team (IM)

BIL: **Essential:** **IM**
Recommended: **ISS**

EDU:	10	12	AD
ISS			I
NS			
PSD			
IM		P	R

Competency 41.8: Identify video formats

Descriptors:

- 41.8.1 Compare/contrast consumer, industrial, and broadcast-grade video cameras
- 41.8.2 Identify the characteristics of various camera formats (e.g., Betacam, VHS, 8mm, super VHS, and DV-Cam)
- 41.8.3 Identify image characteristics affected by camera choice
- 41.8.4 Compare/contrast technical aspects of NTSC, PAL, SECAM, HDTV video signals (scanning, frame rate, frame size, etc.)
- 41.8.5 Describe frame synchronization and time-based correction

Correlated English Language Arts Academic Content Benchmarks

- *Use multiple resources to enhance comprehension of vocabulary.* (Vocabulary E, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Analyze and compare functions and their graphs using attributes, such as rates of change, intercepts and zeros.* (Algebra E, 8-10)

BIL: **Essential:** **IM**
Recommended: **ISS**

EDU:	10	12	AD
ISS			I
NS			
PSD			
IM		P	R

Competency 41.9: Perform editing operations

Descriptors:

- 41.9.1 Identify operational components of video editing systems
- 41.9.2 Compare/contrast linear and nonlinear editing systems
- 41.9.3 Edit digital video, including transitions (e.g., dissolves, wipes, cuts), special effects, and computerized backgrounds
- 41.9.4 Employ the batch capture process
- 41.9.5 Add sound track
- 41.9.6 Add narration and/or voiceover
- 41.9.7 Interpret edit decision lists
- 41.9.8 Employ edit decision lists
- 41.9.9 Perform edits using timelines

Correlated Mathematics Academic Content Benchmarks

- *Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions. (Number G, 8-10)*
- *Write and solve real-world, multi-step problems involving money, elapsed time and temperature, and verify reasonableness of solutions. (Measurement F, 8-10)*

BIL: **Essential:** **IM**
Recommended: **ISS**

EDU:	10	12	AD
ISS			I
NS			
PSD			
IM		P	R

Competency 41.10: Import and export digital video

Descriptors:

- 41.10.1 Describe the characteristics and uses of digitized video
- 41.10.2 Identify digital video bandwidths and their implications
- 41.10.3 Digitize analog video
- 41.10.4 Compress video files using various codes

Correlated Mathematics Academic Content Benchmarks

- *Explain the effects of operations on the magnitude of quantities.* (Number F, 8-10)
- *Apply mathematical knowledge and skills routinely in other content areas and practical situations.* (Math. Process B, 8-10)

Unit 42: Audio Production

BIL: **Essential:** **IM**
Recommended: **ISS**

EDU:	10	12	AD
ISS			I
NS			
PSD			
IM		P	R

Competency 42.1: Demonstrate knowledge of audio recording and sound reinforcement

Descriptors:

- 42.1.1 Describe basic acoustic principles and formulae
- 42.1.2 Differentiate the functions between microphones design
- 42.1.3 Diagram signal flow throughout the recording chain
- 42.1.4 Operate a mixing console/applications, including its input and output functions
- 42.1.5 Edit audio recordings
- 42.1.6 Compare and contrast the properties of analog and digital recording
- 42.1.7 Explain sound reinforcement techniques used for live programs
- 42.1.8 Describe the characteristics and applications of analog signal processing
- 42.1.9 Describe the characteristics and applications of digital signal processing
- 42.1.10 Critique recordings

Correlated English Language Arts Academic Content Benchmarks

- *Use multiple resources to enhance comprehension of vocabulary.* (Vocabulary E, 11-12)

BIL: **Essential:** **IM**
Recommended: **ISS**

EDU:	10	12	AD
ISS			I
NS			
PSD			
IM		P	R

Competency 42.2: Demonstrate knowledge of audio production

Descriptors:

- 42.2.1 Analyze current trends in electronic music
- 42.2.2 Describe MIDI
- 42.2.3 Describe how analog signals are digitized
- 42.2.4 Select music appropriate for a given application
- 42.2.5 Demonstrate digital sampling for compressing sound files
- 42.2.6 Describe methods of analog and digital editing
- 42.2.7 Explain digital audio bandwidths and their implications

- 42.2.8 Describe the various computer hardware and software used in studio recording
- 42.2.9 Describe methods for mastering audio recordings (e.g., in the form of an audiotape, compact disc, DVD)
- 42.2.10 Identify future technologies predicted for audio recording

Correlated English Language Arts Academic Content Benchmarks

- *Use multiple resources to enhance comprehension of vocabulary.* (Vocabulary E, 11-12)

BIL: **Essential:** **IM**
Recommended: **ISS**

EDU:	10	12	AD
ISS			I
NS			
PSD			
IM		I	P

Competency 42.3: Create a sound track

Descriptors:

- 42.3.1 Evaluate performance needs (IM)
- 42.3.2 Evaluate technical resources (IM)
- 42.3.3 Analyze script information to identify sound requirements (IM)
- 42.3.4 Design sound score appropriate to production and post-production needs (IM)
- 42.3.5 Select sound material (IM)
- 42.3.6 Hire talent, if necessary (IM)
- 42.3.7 Coordinate the work of the hired talent (IM)
- 42.3.8 Determine microphone and speaker placement (IM)
- 42.3.9 Incorporate mechanical and electrical sound effects (IM)
- 42.3.10 Discuss audio-for-video recording devices (analog, digital) [IM]
- 42.3.11 Set up audio-for-video recording devices (IM)
- 42.3.12 Operate audio-for-video recording devices (IM)
- 42.3.13 Explain the time-code system for audio-video synchronization (IM)
- 42.3.14 Set up time-code system for audio-video synchronization (IM)
- 42.3.15 Operate time-code system for audio-video synchronization (IM)
- 42.3.16 Identify the parts of an audio mixing console/applications (IM)
- 42.3.17 Operate audio mixing console/applications (IM)
- 42.3.18 Create a MIDI sound score (IM)

Correlated Mathematics Academic Content Benchmarks

- *Write and solve real-world, multi-step problems involving money, elapsed time and temperature, and verify reasonableness of solutions.* (Measurement F, 8-10)

Unit 43: Web Page Design

BIL: **Essential:** **PSD, IM**
Recommended: **ISS**

EDU:	10	12	AD
ISS			I
NS			
PSD		I	P
IM		P	R

Competency 43.1: Demonstrate knowledge of usability and interface design

Descriptors:

- 43.1.1 Discuss ADA section 508 compliancy requirements
- 43.1.2 Discuss assistance devices and their interface with Web pages (PSD)
- 43.1.3 Identify the fundamentals of interface design (e.g., usability, navigation, use of color, functionality) [PSD]
- 43.1.4 Examine psychological and cultural implications

BIL: **Essential:** **PSD, IM**
Recommended: **ISS, NS**

EDU:	10	12	AD
ISS		I	
NS		I	R
PSD		I	P
IM		P	R

Competency 43.2: Demonstrate knowledge of Web programming basics

Descriptors:

- 43.2.1 Recognize the importance of Web programming standards (e.g., World Wide Web Consortium) [PSD]
- 43.2.2 Compare and contrast standard Web programming languages (e.g., Perl, JavaScript, Action Scripting, ASP, PHP, XHTML)
- 43.2.3 Compare and contrast standard Web markup languages (e.g., HTML, XML) [PSD]
- 43.2.4 Demonstrate use of organizational design guidelines
- 43.2.5 Differentiate between various versions of Web programming
- 43.2.6 Identify authoring programs specifically designed for Internet programming production (e.g., Microsoft FrontPage, Macromedia Dreamweaver) [PSD]
- 43.2.7 Identify cross-platform issues (i.e., PC, MAC, UNIX, Linux)
- 43.2.8 Identify new and emerging trends related to Web programming
- 43.2.9 Identify security issues related to client-side processing
- 43.2.10 Create and maintain a basic Web site (PSD)

BIL: **Essential:** **PSD, IM**
Recommended: **ISS, NS**

EDU:	10	12	AD
ISS		I	
NS		I	R
PSD		I	P
IM		I	P

Competency 43.3: Explain basic Web programming

Descriptors:

- 43.3.1 Identify the purpose of Web content delivery enablers (e.g., CGI, API, SSI) [IM, PSD]
- 43.3.2 Discuss client-side processing and its advantages/disadvantages (IM)
- 43.3.3 Identify standard scripting languages (e.g., JavaScript, Visual Basic Script, Action Scripting) [IM]
- 43.3.4 Discuss the uses and advantages/disadvantages of various scripting languages (IM, PSD)
- 43.3.5 Explain how to use a scripting language to program a site (IM)
- 43.3.6 Identify Internet protocol governing bodies (IM, PSD)
- 43.3.7 Explain how to use Internet communication protocols (IM)

BIL: **Essential:** **PSD, IM**
Recommended: **ISS, NS**

EDU:	10	12	AD
ISS			I
NS			P
PSD		I	P
IM		I	P

Competency 43.4: Apply knowledge of Web hosting

Descriptors:

- 43.4.1 Compare the advantages and disadvantages of running one's own server vs. using a server provider (IM, PSD)
- 43.4.2 Identify hardware requirements for a server (IM, PSD)
- 43.4.3 Identify server software options (IM)
- 43.4.4 Demonstrate the process of ordering a domain name (IM)
- 43.4.5 Evaluate hosting providers (e.g., size, legitimacy, security, bandwidth allocation) [IM]
- 43.4.6 Explain how to assign a domain name to a DNS server (IM)
- 43.4.7 Comply with TCP/IP (Transfer Control Protocol/Internet Protocol) [IM]
- 43.4.8 Upload files to the server (IM, PSD)
- 43.4.9 Publicize the site (e.g., optimize search engine placement) (IM)
- 43.4.10 Collect/analyze usage statistics

Correlated Mathematics Academic Content Benchmarks

- *Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions. (Number G, 8-10)*
- *Design and perform a statistical experiment, simulation or study; collect and interpret data; and use descriptive statistics to communicate and support predictions and conclusions. (Data C, 11-12)*

BIL: **Essential:** **PSD, IM**
Recommended: **ISS**

EDU:	10	12	AD
ISS			I
NS			
PSD	I	P	R
IM		P	R

Competency 43.5: Create/maintain a static Web site

Descriptors:

- 43.5.1 Open up a workspace to create a new Internet programming document
- 43.5.2 Create the basic Internet programming structure for a Web page using a text editor or Web development software
- 43.5.3 Explain the advantages of creating short multiple Web pages rather than a single, long Web page
- 43.5.4 Determine logical points to split information into multiple Web pages
- 43.5.5 Build basic navigation based on hyperlinks
- 43.5.6 Create a template file using a text editor
- 43.5.7 Make appropriate changes to template file to create individual pages
- 43.5.8 Insert nondisplayed comments into Internet programming files
- 43.5.9 Display document within a Web browser
- 43.5.10 Make text modifications using a text editor
- 43.5.11 Place different level headings within document using appropriate Internet programming tags
- 43.5.12 Insert paragraph breaks into the text of document using appropriate Internet programming tag
- 43.5.13 Manipulate text cut and paste functions
- 43.5.14 Insert a stylized footer at the bottom of a page
- 43.5.15 Format text
- 43.5.16 Create lists
- 43.5.17 Add graphics/images
- 43.5.18 Add animation

Correlated English Language Arts Academic Content Benchmarks

- *Use revision strategies to improve the style, variety of sentence structure, clarity of controlling idea, logic, effectiveness of word choice and transitions between paragraphs, passages or ideas.* (Writing Process C, 8-10)

BIL: **Essential:** **PSD, IM**
Recommended: **ISS**

EDU:	10	12	AD
ISS		I	
NS			
PSD	I	P	R
IM		P	R

Competency 43.6: **Demonstrate how to format page layout**

Descriptors:

- 43.6.1 Determine targeted devices to be served (e.g., desktop, PDA, tablets, cell phone)
- 43.6.2 Explain Internet programming codes for formatting page layout (e.g., table, CSS)
- 43.6.3 Create a solid color background
- 43.6.4 Calculate the hexadecimal code for a color value
- 43.6.5 Change the color of text and hypertext link items
- 43.6.6 Create a textured background using a graphic file
- 43.6.7 Create various types of hard rule lines for page dividers (e.g., different thicknesses and widths, with and without 3-D shading)
- 43.6.8 Create a table with rows and columns of text in a gridded display
- 43.6.9 Create a layout scheme integrating text and pictures
- 43.6.10 Create an invisible table with side-by-side columns
- 43.6.11 Create a table that has different colored cells
- 43.6.12 Explain interface design
- 43.6.13 Display interlaced images
- 43.6.14 Organize information using frames

Correlated English Language Arts Academic Content Benchmarks

- *Evaluate how features and characteristics make information accessible and usable and how structures help authors achieve their purposes.* (Reading: Informational Text A, 8-10)
- *Analyze whether graphics supplement textual information and promote the author's purpose.* (Reading: Informational Text C, 8-10)

Correlated Mathematics Academic Content Benchmarks

- *Identify subsets of the real number system.* (Number B, 8-10)
- *Explain the effects of operations on the magnitude of quantities.* (Number F, 8-10)
- *Describe and apply the properties of similar and congruent figures; and justify conjectures involving similarity and congruence.*

- Draw and construct representations of two- and three-dimensional geometric objects using a variety of tools, such as straightedge, compass and technology. (Geometry E, 8-10)
- Represent and model transformations in a coordinate plane and describe the results. (Geometry F, 8-10)

BIL: **Essential:** **IM**
Recommended: **ISS, NS, PSD**

EDU:	10	12	AD
ISS		I	
NS			I
PSD		I	R
IM		I	P

Competency 43.7: Demonstrate how to add audio and video to a Web page

Descriptors:

- 43.7.1 Define the process of delivering audio and video signals in real time (streaming) [IM]
- 43.7.2 Assess audio sweetening techniques for the Web (IM)
- 43.7.3 Define appropriate CODECS used for Web design (IM)
- 43.7.4 Embed audio and video to a Web page (IM)
- 43.7.5 Establish network administration procedures for audio and video (IM)

BIL: **Essential:** **PSD, IM**
Recommended: **ISS, NS**

EDU:	10	12	AD
ISS		I	
NS			I
PSD	I	P	R
IM		P	R

Competency 43.8: Demonstrate how to link documents

Descriptors:

- 43.8.1 Identify the function and structure of URLs (Uniform Resource Locators)
- 43.8.2 Identify the significance of a file called index.html on a Web server
- 43.8.3 Copy URLs from a Web browser to an Internet programming text document
- 43.8.4 Demonstrate the use of anchors in Web pages
- 43.8.5 Attach a hyperlink to graphics
- 43.8.6 Create a hypertext link that will send an e-mail message
- 43.8.7 Differentiate between client-side image mapping and server-side image mapping
- 43.8.8 Create images with linkable hot spots

Unit 44: Business Processes for IT Professionals

This unit details the methodology for the development, implementation, and monitoring of an IT-related work product or system. It is strongly recommended that the process oriented competencies in this unit be taught in conjunction with (not separate from) the technical, workplace, and academic skills outlined in other units.

Initiation/Planning Phase- Project Planning

BIL: Essential: ISS, NS, PSD, IM

EDU:	10	12	AD
ISS	I	P	R
NS		P	R
PSD	I	P	R
IM		P	R

Competency 44.1: Demonstrate knowledge of project planning methodology

Descriptors:

- 44.1.1 Define terms associated with project planning
- 44.1.2 Identify steps associated with project planning
- 44.1.3 Identify methodologies associated with project planning
- 44.1.4 Define the project's contribution to business needs
- 44.1.5 Identify stakeholders and decision makers
- 44.1.6 Define the scope of the project
- 44.1.7 Evaluate project requirements
- 44.1.8 Develop task list (e.g., work breakdown structures)
- 44.1.9 Prioritize tasks according to business needs
- 44.1.10 Identify required resources and budget
- 44.1.11 Develop initial project management flowchart
- 44.1.12 Identify critical milestones
- 44.1.13 Evaluate risks
- 44.1.14 Prepare contingency plan
- 44.1.15 Develop a method of evaluation
- 44.1.16 Explain alternative development methodologies

Correlated English Language Arts Academic Content Benchmark

- *Produce functional documents that report, organize and convey information and ideas accurately, foresee readers' problems or misunderstandings and include formatting techniques that are user friendly. (Writing Applications C, 11-12)*

Correlated Mathematics Academic Content Benchmarks

- *Explain difference among accuracy, precision and error, and describe how each of those can affect solutions in measurement situations. (Measurement A, 11-12)*
- *Evaluate the validity of claims and predictions that are based on data by examining the appropriateness of the data collections and analysis. (Data E. 8-10)*
- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators. (Data A, 11-12)*
- *Apply mathematical knowledge and skills routinely in other content areas and practical situations. (Math. Process B, 8-10)*
- *Generalize and explain patterns and sequences in order to find the next term and the nth term. (Algebra A, 8-10)*

Requirements Analysis Phase

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS		I	P
NS		I	P
PSD		I	P
IM		I	P

Competency 44.2: Conduct requirements analysis

Descriptors:

- 44.2.1 Identify business needs/expectations (PSD, NS, IM, ISS)
- 44.2.2 Analyze use of product or system (PSD, NS, IM, ISS)
- 44.2.3 Specify functional requirements (NS, IM, ISS)
- 44.2.4 Specify data requirements (NS, IM, ISS)
- 44.2.5 Describe how processes and data support business expectations (PSD, NS, IM, ISS)
- 44.2.6 Develop test criteria and plans (NS, IM, ISS)
- 44.2.7 Revise documentation prepared in initiation/planning phase as needed (NS, IM, ISS)
- 44.2.8 Generate task status report (NS, IM, ISS)
- 44.2.9 Track critical milestones (NS, IM, ISS)
- 44.2.10 Participate in project phase review (NS, IM, ISS)
- 44.2.11 Report project status (NS, IM, ISS)

Correlated English Language Arts Academic Content Benchmarks

- *Use revision strategies to improve the style, variety of sentence structure, clarity of controlling idea, logic, effectiveness of word choice and transitions between paragraphs, passages or ideas. (Writing Process C, 8-10)*
- *Use a variety of strategies to revise content, organization and style, and to improve word choice, sentence variety, clarity and consistency of writing. (Writing Process C, 8-10; Writing Process C, 11-12)*

- *Produce functional documents that report, organize and convey information and ideas accurately, foresee readers' problems or misunderstandings and include formatting techniques that are user friendly.* (Writing Applications C, 11-12)
- *Compile, organize and evaluate information, take notes and summarize findings.* (Research B, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Evaluate the validity of claims and predictions that are based on data by examining the appropriateness of the data collection and analysis.* (Data E, 8-10)
- *Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data F, 8-10)
- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators.* (Data A, 11-12)
- *Use descriptive statistics to analyze and summarize data, including measures of center, dispersion, correlation and variability.* (Data B, 11-12)
- *Connect statistical techniques to applications in workplace and consumer situations.* (Data D, 11-12)
- *Locate and interpret mathematical information accurately, and communicate ideas, processes and solutions in a complete and easily understood manner.* (Math. Process H, 8-10)
- *Apply mathematical modeling to workplace and consumer situations, including problem formulation, identification of a mathematical model, interpretations of solution within the model, and validation to original problem situation.* (Math. Process J, 11-12)

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS		I	P
NS		I	P
PSD		I	P
IM		I	P

Competency 44.3: Demonstrate knowledge of the requirements analysis phase

Descriptors:

- 44.3.1 Identify business expectations (PSD, ISS, NS, IM)
- 44.3.2 Explain how implementation will impact the environment (NS, IM)
- 44.3.3 Explain budget and time restraints (ISS, NS, IM)
- 44.3.4 Explain how the business environment impacts requirements (e.g., risks and rewards) [NS, IM]
- 44.3.5 Explain how internal and external forces impact project requirements (ISS, NS, IM)
- 44.3.6 Explain how legal and regulatory issues impact project requirements (NS, IM)

Correlated English Language Arts Academic Content Benchmarks

- *Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing). [Reading Process B, 11-12]*

Design/Development Phase

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS		I	P
NS		I	P
PSD		I	P
IM		I	P

Competency 44.4: Identify current technical environment

Descriptors:

- 44.4.1 Identify current internal and external technical resources (NS, ISS, IM)
- 44.4.2 Identify current internal and external technology (PSD, NS, ISS, IM)
- 44.4.3 Identify internal and external processes (NS, ISS, IM)

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS		I	P
NS		I	P
PSD		I	P
IM		I	P

Competency 44.5: Demonstrate knowledge of design alternatives and options

Descriptors:

- 44.5.1 Determine return on investment (ROI) [e.g., cost-benefit analysis] [NS, ISS, IM]
- 44.5.2 Explain Total Cost of Ownership (TCO) [PSD, NS, ISS, IM]
- 44.5.3 Define risks and rewards for each option (NS, ISS, IM)
- 44.5.4 Explain the components of “build versus buy” (PSD, NS, ISS, IM)
- 44.5.5 Explain processes to compare design versus requirements (NS, ISS, IM)

Correlated Mathematics Academic Content Benchmarks

- *Evaluate the validity of claims and predictions that are based on data by examining the appropriateness of the data collections and analysis. (Data E. 8-10)*
- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators. (Data A, 11-12)*
- *Apply mathematical knowledge and skills routinely in other content areas and practical situations. (Math. Process B, 8-10)*
- *Connect statistical techniques to applications in workplace and consumer situations. (Data D, 11-12)*

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS		I	P
NS		I	P
PSD	I	R	P
IM		I	P

Competency 44.6: Demonstrate knowledge of how systems and products are developed

Descriptors:

- 44.6.1 Define components that go into the development plan (e.g., hardware, software, communications) [PSD, ISS, NS, IM]
- 44.6.2 Explain what makes a good development plan (e.g., end-user involvement, programming code reviews) [PSD, ISS, NS, IM]
- 44.6.3 Identify documentation requirements in initiation/planning phase as needed (ISS, NS, IM)
- 44.6.4 Explain project status report (ISS, NS, IM)
- 44.6.5 Define purpose of critical milestones and paths (ISS, NS, IM)
- 44.6.6 Discuss need for project phase review (ISS, NS, IM)
- 44.6.7 Report project status (ISS, NS, IM)

Correlated English Language Arts Academic Content Benchmarks

- *Produce functional documents that report, organize and convey information and ideas accurately, foresee readers' problems or misunderstandings and include formatting techniques that are user friendly.* (Writing Applications C, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Use precise mathematical language and notations to represent problem situations and mathematical ideas.* (Math. Process F, 8-10)
- *Write clearly and coherently about mathematical thinking and ideas.* (Math. Process G, 8-10)

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS		I	P
NS		P	R
PSD		I	P
IM		I	P

Competency 44.7: Discuss solutions versus requirements

Descriptors:

- 44.7.1 Explain how unit testing is used to validate requirements (PSD, ISS, IM)
- 44.7.2 Explain the purpose of technical review (ISS, IM)
- 44.7.3 Explain the purpose of end-user solution review (ISS, IM)

Correlated Mathematics Academic Content Benchmarks

- *Describe sampling methods and analyze the effects of method chosen regarding how well the resulting sample represents the population. (Data G, 8-10)*

Quality Assurance and Testing

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS		I	P
NS		I	P
PSD		I	P
IM		I	P

Competency 44.8: Explain quality assurance processes

Descriptors:

- 44.8.1 Discuss the historical evolution of quality assurance initiatives (ISS, NS, IM)
- 44.8.2 Interpret quality management terminology (NS)
- 44.8.3 Identify the role of quality within the organization (ISS, NS, IM)
- 44.8.4 Identify the features and benefits of quality planning (PSD, NS)
- 44.8.5 Discuss the relationship among organizational structures, policies, procedures and quality assurance (NS, IM)
- 44.8.6 Identify successful efforts by industry to improve quality and/or reduce costs (NS)
- 44.8.7 Differentiate between prevention and detection (ISS, NS)
- 44.8.8 Differentiate between variable and attribute data
- 44.8.9 Identify types of control charts
- 44.8.10 Explain how statistical techniques are used to control quality

Correlated Mathematics Academic Content Benchmarks

- *Evaluate the validity of claims and predictions that are based on data by examining the appropriateness of the data collection and analysis. (Data E, 8-10)*
- *Construct convincing arguments based on analysis of data and interpretation of graphs. (Data F, 8-10)*
- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators. (Data A, 11-12)*
- *Use descriptive statistics to analyze and summarize data, including measures of center, dispersion, correlations and variability. (Data B, 11-12)*
- *Design and perform a statistical experiment, simulation or study; collect and interpret data; and use descriptive statistics to communicate and support predictions and conclusions. (Data C, 11-12)*

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS		I	P
NS		I	P
PSD		I	P
IM		P	R

Competency 44.9: Demonstrate knowledge of the testing environment

Descriptors:

- 44.9.1 Identify the purpose of integration testing (ISS, NS)
- 44.9.2 Identify the purpose of system testing (ISS, NS)
- 44.9.3 Identify the purpose of security testing (ISS, NS)
- 44.9.4 Identify the purpose of acceptance testing (PSD, ISS, NS)

Implementation Phase

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS		I	P
NS		I	P
PSD		I	P
IM		I	P

Competency 44.10: Describe key components of an implementation plan (e.g., communication, business continuity plan)

Descriptors:

- 44.10.1 Identify turn-back points (e.g., go or no-go) [NS, IM, ISS]
- 44.10.2 Identify new work processes and procedures (PSD, NS, IM, ISS)
- 44.10.3 Identify steps all business units must take to implement (NS, IM, ISS)
- 44.10.4 Identify decision criteria for retiring old solution (i.e., displaced technology) [NS, IM, ISS]

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS		P	R
NS		P	R
PSD		P	R
IM		P	R

Competency 44.11: Explain the value a communication plan can provide to implementation

Descriptors:

- 44.11.1 Identify communication vehicles
- 44.11.2 Identify components of a communication plan

- 44.11.3 Explain the importance of audience when developing a communication plan
- 44.11.4 Describe types of communication channels (e.g., formal vs. informal)
- 44.11.5 Define stakeholder relationships (e.g., customer, employers, shareholders, suppliers)

Correlated English Language Arts Academic Content Benchmarks

- *Select and use effective speaking strategies for a variety of audiences, situations and purposes.* (Communication C, 11-12)

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS		I	P
NS		I	P
PSD		I	P
IM		I	P

Competency 44.12: Explain the value a training plan can provide to implementation

Descriptors:

- 44.12.1 Identify components of training plan (ISS, IM, NS)
- 44.12.2 Identify common training methodologies (e.g., computer-based, hands on) [ISS, IM, NS]
- 44.12.3 Identify strengths and weaknesses of each methodology (ISS, IM, NS)
- 44.12.4 Identify functions of a training plan (PSD, ISS, IM, NS)

Correlated English Language Arts Academic Content Benchmarks

- *Select and use effective speaking strategies for a variety of audiences, situations and purposes.* (Communication C, 11-12)

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS		P	R
NS		I	P
PSD		I	P
IM		I	P

Competency 44.13: Explain how business continuity plans (e.g., disaster recovery, roll-back) interrelate with implementation plans

Descriptors:

- 44.13.1 Describe purpose and components of a roll-back plan (e.g., go-no-go) [IM, NS]
- 44.13.2 Describe purpose and components of a fall-back plan (e.g., disaster recovery plan) [PSD, IM, NS]
- 44.13.3 Describe purpose and components of a business continuity plan (IM, NS)

Maintenance/Operations Phase

BIL: **Essential:** **ISS NS, PSD, IM**

EDU:	10	12	AD
ISS		I	P
NS		I	P
PSD		I	P
IM		I	P

Competency 44.14: Demonstrate knowledge of information technology operations and maintenance

Key Indicators

Descriptors:

- 44.14.1 Describe maintenance and operations phase (ISS, NS, IM)
- 44.14.2 Identify systems operations (ISS, IM)
- 44.14.3 Define problem and modification process (PSD, ISS, IM)
- 44.14.4 Define steps to maintain system (ISS, IM)
- 44.14.5 Revise previous documentation as needed (ISS, IM)

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS		I	P
NS		I	P
PSD		I	P
IM		I	P

Competency 44.15: Explain the role of maintenance as part of the IT function

Descriptors:

- 44.15.1 Define components of maintenance contracts (PSD, ISS, IM, NS)
- 44.15.2 Define upgrade process (ISS, IM, NS)
- 44.15.3 Define Service Level Agreements (SLAs) [ISS, IM, NS]

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS		I	P
NS		I	P
PSD		I	P
IM		I	P

Competency 44.16: Define components of incidence and problem management

Descriptors:

- 44.16.1 Define escalation process (NS, IM)

- 44.16.2 Explain different methodologies for event notification (e.g., paging, e-mail) [ISS, PSD, NS, IM]
- 44.16.3 Explain support contract (ISS, NS, IM)

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS		I	P
NS		I	P
PSD		I	P
IM		I	P

Competency 44.17: Identify components of change management process

Descriptors:

- 44.17.1 Define the change and value of change (ISS, IM, NS)
- 44.17.2 Define when to do change (ISS, IM, NS)
- 44.17.3 Explain what change entails (ISS, IM, NS)
- 44.17.4 Explain the impact of change (ISS, PSD, NS)
- 44.17.5 Contact all affected parties (ISS, IM, NS)
- 44.17.6 Identify back-up plan (IM, ISS, NS)

Unit 45: Business Law and Legal Issues

BIL: Essential: ISS, NS, PSD, IM

EDU:	10	12	AD
ISS	I	R	P
NS		P	R
PSD	I	P	R
IM		P	R

Competency 45.1: Define intellectual property rights covered by intellectual law

Descriptors:

- 45.1.1 Distinguish among the various forms of intellectual property rights (e.g., copyright, patent, trademark, trade secrets) [ISS]
- 45.1.2 Define plagiarism (ISS)
- 45.1.3 Define authorship (ISS)
- 45.1.4 Define work made for hire (ISS)
- 45.1.5 Define fair use (ISS)
- 45.1.6 Differentiate the rights granted under copyright, patent, and trademark (ISS)
- 45.1.7 Identify the rights related to electronic imagery (ISS)
- 45.1.8 Discuss consequences of violation of copyright trademark and patent law (ISS)
- 45.1.9 Identify the liability for invasion of privacy (ISS)
- 45.1.10 Identify the liability for slander and libel (ISS)
- 45.1.11 Identify legal terms related to IT (ISS)
- 45.1.12 Discuss licensing issues (ISS)
- 45.1.13 Discuss confidentiality issues and their liability implications

Correlated English Language Arts Academic Content Benchmarks

- *Use style guides to produce oral and written reports that give proper credit for sources (e.g., words, ideas, images, information) and include an acceptable format for source acknowledgement. (Research D, 8-10; Research D, 11-12)*

BIL: Essential: ISS, NS, PSD, IM

EDU:	10	12	AD
ISS		I	P
NS		I	P
PSD		I	P
IM		I	P

Competency 45.2: Describe the components of contracts

Descriptors:

- 45.2.1 Define statement of work (NS, IM, ISS)
- 45.2.2 Define duration (NS, ISS, IM)
- 45.2.3 Define liabilities (NS, ISS, IM)
- 45.2.4 Define termination clause (NS, ISS, IM)

- 45.2.5 Define service level agreements (PSD, NS, ISS, IM)
- 45.2.6 Define exclusions (NS, ISS, IM)
- 45.2.7 Define warranties ((NS, ISS, IM)
- 45.2.8 Explain dispute resolution (NS, ISS, IM)
- 45.2.9 Define terms and conditions (NS, ISS, IM)

BIL: **Essential:** **ISS NS, PSD, IM**

EDU:	10	12	AD
ISS		I	P
NS		I	P
PSD		I	P
IM		I	P

Competency 45.3: Identify current regulatory issues (e.g., HIPAA, Gramm-Leach-Bliley, Sarbanes-Oxley, NSA–National Security Act, Homeland Security)

Descriptors:

- 45.3.1 Explain the impact of regulatory compliance issues on the design and development process (PSD, NS, ISS, IM)
- 45.3.2 Define/explain the impact of non-compliance to the company/organization (PSD, NS, IM, ISS)
- 45.3.3 Explain risk of non-compliance to the company/organization (PSD, NS, ISS, IM)

Unit 46: Technical Writing and Documentation

BIL: Essential: ISS, NS, PSD, IM

EDU:	10	12	AD
ISS		I	P
NS		P	R
PSD		I	P
IM		I	P

Competency 46.1: Evaluate technical writing requirements

Descriptors:

- 46.1.1 Define/prioritize communication needs (PSD, ISS, IM)
- 46.1.2 Resolve conflicting requirements (ISS)
- 46.1.3 Specify project objectives (PSD, ISS)
- 46.1.4 Determine the size and specifics of the work to be completed (PSD, ISS)
- 46.1.5 Estimate time, materials, and capabilities needed to complete assignment (ISS)
- 46.1.6 Identify criteria for successful completion of project (ISS)
- 46.1.7 Evaluate strengths and weaknesses of completed project (ISS)

Correlated English Language Arts Academic Content Benchmarks

- *Select and use an appropriate organizational structure to refine and develop ideas for writing.* (Writing Process B, 11-12)

BIL: Essential: ISS, NS, PSD, IM

EDU:	10	12	AD
ISS		I	P
NS		P	R
PSD		I	P
IM		I	P

Competency 46.2: Write technical reports

Descriptors:

- 46.2.1 Determine audience (PSD, ISS, IM)
- 46.2.2 Access needed information using standard references and sources (ISS, IM)
- 46.2.3 Identify type of report needed (ISS, IM)
- 46.2.4 Compile relevant data (ISS, IM)
- 46.2.5 Organize data into charts and graphs (ISS, IM)
- 46.2.6 Analyze data (ISS, IM)
- 46.2.7 Draw conclusions from data analysis (ISS, IM)
- 46.2.8 Outline report (ISS, IM)
- 46.2.9 Draft report (ISS, IM)
- 46.2.10 Edit report (e.g., check spelling, grammar, punctuation, sentence structure, accuracy of content) [ISS, IM]
- 46.2.11 Review report with peers (ISS, IM)

- 46.2.12 Revise report as needed based on peer feedback (ISS, IM)
- 46.2.13 Proofread revised report (ISS, IM)
- 46.2.14 Present reports (ISS, IM)

Correlated English Language Arts Academic Content Benchmarks

- *Formulate writing ideas, and identify a topic appropriate to the purpose and audience. (Writing Process A, 8-10; Writing Process A, 11-12)*
- *Determine the usefulness of organizers and apply appropriate pre-writing tasks. (Writing Process B, 8-10)*
- *Select and use an appropriate organizational structure to refine and develop ideas for writing. (Writing Process B, 11-12)*
- *Produce functional documents that report, organize and convey information and ideas accurately, foresee readers' problems or misunderstandings and include formatting techniques that are user friendly. (Writing Applications C, 11-12)*
- *Produce informational essays or reports that establish a clear and distinctive perspective on the subject, include relevant perspectives, take into account the validity and reliability of sources and provide a clear sense of closure. (Writing Applications D, 11-12)*
- *Use revision strategies to improve the style, variety of sentence structure, clarity of controlling idea, logic, effectiveness of word choice and transitions between paragraphs, passages or ideas. (Writing Process C, 8-10; Writing Process C, 11-12)*
- *Edit to improve sentence fluency, grammar and usage. (Writing Process D, 8-10)*
- *Prepare writing for publication that is legible, follows an appropriate format and uses techniques such as electronic resources and graphics. (Writing Process F, 8-10)*

Correlated Mathematics Academic Content Benchmarks

- *Find, use and interpret measures of center and spread, such as mean and quartiles, and use those measures to compare and draw conclusions about sets of data. (Data D, 8-10)*
- *Evaluate the validity of claims and predictions that are based on data by examining the appropriateness of the data collection and analysis. (Data E, 8-10)*
- *Construct convincing arguments based on analysis of data and interpretation of graphs. (Data F, 8-10)*
- *Describe sampling methods and analyze the effects of method chosen regarding how well the resulting sample represents the population. (Data G, 8-10)*
- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators. (Data A, 11-12)*
- *Use descriptive statistics to analyze and summarize data, including measures of center, dispersion, correlation and variability. (Data B, 11-12)*
- *Design and perform a statistical experiment, simulation or study; collect and interpret data; and use descriptive statistics to communicate and support predictions and conclusions. (Data C, 11-12)*
- *Connect statistical techniques to applications in workplace and consumer situations. (Data D, 11-12)*

- *Locate and interpret mathematical information accurately, and communicate ideas, processes and solutions in a complete and easily understood manner. (Math. Process H, 8-10)*

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS		I	P
NS		P	R
PSD		I	P
IM		I	P

Competency 46.3: Conduct technical research

Descriptors:

- 46.3.1 Identify target audience (PSD, ISS, IM)
- 46.3.2 Define research questions (ISS, IM)
- 46.3.3 Determine priorities for the information that should be gathered (ISS, IM)
- 46.3.4 Identify potential sources of information (ISS, IM)
- 46.3.5 Target audience/user group as a key information source (ISS, IM)
- 46.3.6 Identify subject matter experts (ISS, IM)
- 46.3.7 Evaluate potential sources of information based on established criteria (e.g., affordability, relevance) [ISS, IM]
- 46.3.8 Conduct interviews with selected human information sources (ISS)
- 46.3.9 Gather information from selected print and electronic sources (ISS)
- 46.3.10 Determine the accuracy and completeness of the information gathered (ISS)

Correlated English Language Arts Academic Content Benchmarks

- *Formulate open-ended research questions suitable for inquiry and investigation and adjust questions as necessary while research is conducted. (Research A, 8-10; Research A, 11-12)*
- *Evaluate the usefulness and credibility of data and sources. (Research B, 8-10)*
- *Evaluate the usefulness and credibility of data and sources, and synthesize information from multiple sources. (Research C, 11-12)*
- *Organize information from various resources and select appropriate sources to support central ideas, concepts and themes. (Research C, 8-10)*
- *Compile, organize and evaluate information, take notes and summarize findings. (Research B, 11-12)*

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS		I	P
NS		P	R
PSD	I	R	P
IM	I	P	R

Competency 46.4: Design technical documentation

Descriptors:

- 46.4.1 Define purpose of documentation (PSD, ISS)
- 46.4.2 Specify standards for documentation, including critical success criteria (ISS)
- 46.4.3 Identify delivery options (ISS)
- 46.4.4 Evaluate cost-effectiveness of each delivery option (ISS)
- 46.4.5 Select tools appropriate for task purpose (ISS)
- 46.4.6 Plan information flow (ISS)
- 46.4.7 Select writing style and tone appropriate for given documentation (ISS)
- 46.4.8 Determine level of detail needed (ISS)
- 46.4.9 Identify visuals appropriate for given documentation (ISS)
- 46.4.10 Provide feedback on design to development team/individual (ISS)

Correlated English Language Arts Academic Content Benchmarks

- *Formulate writing ideas, and identify a topic appropriate to the purpose and audience.* (Writing Process A, 8-10; Writing Process A, 11-12)
- *Determine the usefulness of organizers and apply appropriate pre-writing tasks.* (Writing Process B, 8-10)
- *Select and use an appropriate organizational structure to refine and develop ideas for writing.* (Writing Process B, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators.* (Data A, 11-12)
- *Apply mathematical knowledge and skills routinely in other content areas and practical situations.* (Math. Process B, 8-10)

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS		I	P
NS		P	R
PSD		I	P
IM		I	P

Competency 46.5: Develop technical documentation

Descriptors:

- 46.5.1 Determine audience (ISS, IM)
- 46.5.2 Identify parameters (ISS, IM)
- 46.5.3 Interpret specifications or drawings for target audience (ISS, IM)
- 46.5.4 Record process (e.g., flowchart, step-by-step narrative) [ISS, IM]
- 46.5.5 Record data (ISS, IM)
- 46.5.6 Maintain test logs (PSD, ISS, IM)
- 46.5.7 Compile cumulative reference/record (ISS, IM)
- 46.5.8 Measure compliance with established parameters (ISS, IM)
- 46.5.9 Verify the accuracy and validity of the information (ISS, IM)

- 46.5.10 Select and organize information (ISS, IM)
- 46.5.11 Present content in clear and concise way (ISS, IM)
- 46.5.12 Employ presentation tools and techniques appropriate for the given documentation (ISS, IM)
- 46.5.13 Obtain feedback on the information provided and its technical accuracy (ISS, IM)
- 46.5.14 Test documentation for usability (ISS, IM)
- 46.5.15 Edit documentation for readability, grammar, and usage (ISS, IM)
- 46.5.16 Maintain required logs (ISS, IM)
- 46.5.17 Track expenses involved (ISS, IM)

Correlated English Language Arts Academic Content Benchmarks

- *Formulate writing ideas, and identify a topic appropriate to the purpose and audience.* (Writing Process A, 8-10; Writing Process A, 11-12)
- *Evaluate the usefulness and credibility of data and sources.* (Research B, 8-10)
- *Evaluate the usefulness and credibility of data and sources, and synthesize information from multiple sources.* (Research C, 11-12)
- *Organize information from various resources and select appropriate sources to support central ideas, concepts and themes.* (Research C, 8-10)
- *Compile, organize and evaluate information, take notes and summarize findings.* (Research B, 11-12)
- *Give presentations using a variety of delivery methods, visual displays and technology.* (Communication G, 8-10; Communication F, 11-12)
- *Edit to improve sentence fluency, grammar and usage.* (Writing Process D, 8-10)
- *Apply tools to judge the quality of their writing.* (Writing Process E, 8-10)
- *Prepare writing for publication that follows an appropriate format and uses a variety of techniques to enhance the final product.* (Writing Process F, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Evaluate the validity of claims and predictions that are based on data by examining the appropriateness of the data collection and analysis.* (Data E, 8-10)
- *Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data F, 8-10)
- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators.* (Data A, 11-12)
- *Design and perform a statistical experiment, simulation or study; collect and interpret data; and use descriptive statistics to communicate and support predictions and conclusions.* (Data C, 11-12)
- *Connect statistical techniques to applications in workplace and consumer situations.* (Data D, 11-12)
- *Locate and interpret mathematical information accurately, and communicate ideas, processes and solutions in a complete and easily understood manner.* (Math. Process H, 8-10)
- *Apply mathematical modeling to workplace and consumer situations, including problem formulation, identification of a mathematical model, interpretations of solution within the model, and validation to original problem situation.* (Math. Process J, 11-12)

Unit 47: Professional Practices

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS		I	P
NS		P	R
PSD	I	P	R
IM		I	P

Competency 47.1: Identify legal and ethical behavior

Descriptors:

- 47.1.1 Differentiate between legal and ethical behavior (ISS, IM)
- 47.1.2 Explain terms, principles, and characteristics of legal and ethical behavior (e.g., loyalty, discretion, solicitation, competitor, supplier) [ISS, IM]
- 47.1.3 Explain legal ramifications of breaching rules and regulations (ISS, IM)
- 47.1.4 Explain the effects and consequences of unethical and/or unlawful behavior (ISS, IM)

Correlated English Language Arts Academic Content Benchmarks

- *Use multiple resources to enhance comprehension of vocabulary.* (Vocabulary E, 11-12)

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS		P	R
NS		P	R
PSD	I	P	R
IM	I	P	R

Competency 47.2 Explain professional responsibilities

Descriptors:

- 47.2.1 Explain the need for professional and ethical standards
- 47.2.2 Explain responsibility of the individual to apply ethical standards
- 47.2.3 Identify responsibility to clients(s) and employer(s)
- 47.2.4 Explain importance of conflict resolution in the workplace

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS		I	P
NS		P	R
PSD		I	P
IM		I	P

Competency 47.3: Explain the role of the IT professional in maintaining customer satisfaction

Descriptors:

- 47.3.1 Explain the nature of positive customer/client relations (ISS, IM)
- 47.3.2 Describe the importance of all customers to the business (PSD, ISS, IM)
- 47.3.3 Explain the importance of interaction with customers in a professional manner (ISS, IM)
- 47.3.4 Explain the importance of maintaining customer base (ISS, IM)
- 47.3.5 Determine appropriate communication vehicles (phone, e-mail, face-to-face) [PSD, ISS, IM]
- 47.3.6 Differentiate internal vs. external customer service (cost of existing versus new) [ISS, IM]
- 47.3.7 Discuss the role of company image (ISS, IM)
- 47.3.8 Discuss the role of customer feedback in customer satisfaction (ISS, IM)
- 47.3.9 Define function of call center (PSD, ISS, IM)
- 47.3.10 Identify customer expectations (ISS, IM)

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS		I	P
NS		P	R
PSD		I	P
IM		I	P

Competency 47.4: Explain the importance of teams in achieving IT project goals

Descriptors:

- 47.4.1 Identify desired group and team behavior in an IT context (PSD, ISS, IM)
- 47.4.2 Explain the importance of cross-functional teams in the IT environment (ISS, IM)
- 47.4.3 Define roles/responsibilities within the group decision making process (PSD, ISS, IM)
- 47.4.4 Identify ways to assess team productivity and results (ISS, IM)

Correlated Mathematics Academic Content Benchmarks

- *Connect statistical techniques to applications in workplace and consumer situations. (Data D, 11-12)*

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS		I	P
NS		P	R
PSD		I	P
IM	I	P	R

Competency 47.5: Explain the importance of professional behavior in the IT environment

Descriptors:

- 47.5.1 Identify appropriate resources for company policies affecting professional behavior (e.g., organizational policies, personnel handbooks, and manuals) [PSD, ISS]
- 47.5.2 Discuss how specific organizational policies and rules influence a specific work situation (ISS)
- 47.5.3 Explain the importance of self-discipline, positive attitude and integrity in a work situation (e.g., attendance, personal appearance) [PSD, ISS]
- 47.5.4 Explain the importance of flexibility and willingness to learn new skills and knowledge (PSD, ISS)

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS	I	R	P
NS		P	R
PSD		I	P
IM	I	P	R

Competency 47.6: Explain the importance of health and safety standards and concepts in the IT workplace

Descriptors:

- 47.6.1 Explain the relationship between health, safety and productivity (ISS)
- 47.6.2 Identify sources of safety information (e.g., company procedural manuals, documentation, standards, flowcharts) [ISS]
- 47.6.3 Explain the importance of maintaining a safe work area (ISS)
- 47.6.4 Explain how ergonomics and repetitive strain injury impact IT professionals (PSD, ISS)

Correlated English Language Arts Academic Content Benchmarks

- *Use multiple resources to enhance comprehension of vocabulary.* (Vocabulary E, 11-12)

Unit 48: Basic Business Concepts

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS		I	P
NS		P	R
PSD	I	R	P
IM		I	P

Competency 48.1: Explain business ownership

Descriptors:

- 48.1.1 Define types of business ownership (e.g., sole proprietorship, partnership) [PSD, ISS, IM]
- 48.1.2 Explain the advantages and disadvantages of the different forms of business ownership (ISS, IM)
- 48.1.3 Identify variations in ownership forms (ISS, IM)
- 48.1.4 Explain how business organization ownership can evolve over time (ISS, IM)

Correlated English Language Arts Academic Content Benchmark

- *Use multiple resources to enhance comprehension of vocabulary.* (Vocabulary F, 8-10; Vocabulary E, 11-12)

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS		I	P
NS		P	R
PSD		I	P
IM		I	P

Competency 48.2: Explain basic business organization and structure

Descriptors:

- 48.2.1 Differentiate between divisional and departmental structures (e.g., customer, geographic and product) [PSD, ISS, IM]
- 48.2.2 Identify types of organizational structures (e.g., organic, matrix, mechanistic) [PSD, ISS, IM]
- 48.2.3 Explain how internal and external forces impact the requirements for tech or service implementation (e.g., size, complexity, profitability) [PSD, ISS, IM]

Correlated Mathematics Academic Content Benchmarks

- *Locate and interpret mathematical information accurately, and communicate ideas, processes and solutions in a complete and easily understood manner.* (Math. Process H, 8-10)
- *Apply mathematical modeling to workplace and consumer situations, including problem formulation, identification of mathematical model, interpretation of solution with the model, and validation to original problem situation.* (Math. Process J, 11-12)

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS		I	P
NS		I	P
PSD		I	P
IM		I	P

Competency 48.3: Discuss the role of IT in meeting business strategic objectives

Descriptors:

- 48.3.1 Identify common sources outlining strategic business objectives (NS, ISS, IM)
- 48.3.2 Define typical business objectives (PSD, ISS, IM)
- 48.3.3 Identify ways in which business objectives are measured (e.g., key performance indicators) [NS, ISS, IM]
- 48.3.4 Identify business stakeholders (e.g., shareholders, customers, suppliers) (NS, ISS, IM)
- 48.3.5 Discuss how IT functions impact business objectives (NS, ISS, IM)
- 48.3.6 Discuss obstacles in measuring the impact of IT functions on business objectives (NS, ISS, IM)

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS		I	P
NS		P	R
PSD		I	P
IM		I	P

Competency 48.4: Explain how IT functions interface with other business functions

Descriptors:

- 48.4.1 Explain the role of IT in the business organization (PSD, ISS, IM)
- 48.4.2 Explain how IT interfaces with the human resource function (ISS, IM)

- 48.4.3 Explain how IT interfaces with the finance and accounting functions (ISS, IM)
- 48.4.4 Explain how IT interfaces with the production/manufacturing functions (ISS, IM)
- 48.4.5 Explain how IT interfaces with the sales, marketing, and distribution functions (ISS, IM)

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS		I	P
NS		I	P
PSD		I	P
IM		I	P

Competency 48.5: Determine factors affecting business risk

Descriptors:

- 48.5.1 Define business risk (PSD, NS, ISS, IM)
- 48.5.2 Identify types of business risks (NS, ISS, IM)
- 48.5.3 Describe ways to minimize business risks (NS, ISS, IM)
- 48.5.4 Identify factors affecting a business' profit (NS, ISS, IM)

Correlated Mathematics Academic Content Benchmarks

- *Explain difference among accuracy, precision and error, and describe how each of those can affect solutions in measurement situations. (Measurement A, 11-12)*
- *Evaluate the validity of claims and predictions that are based on data by examining the appropriateness of the data collections and analysis. (Data E. 8-10)*
- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators. (Data A, 11-12)*
- *Apply mathematical knowledge and skills routinely in other content areas and practical situations. (Math. Process B, 8-10)*

BIL: **Recommended: ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS		I	P
NS		I	R
PSD			I
IM		I	P

Competency 48.6: Explain basic accounting concepts

Descriptors:

- 48.6.1 Define accounting and explain the purpose of the accounting system

- 48.6.2 Explain basic accounting principles and applications
- 48.6.3 Identify appropriate accounting concepts and techniques for acquisition, depreciation, and disposal of property, plant, and equipment

Correlated English Language Arts Academic Content Benchmark

- *Use multiple resources to enhance comprehension of vocabulary.* (Vocabulary F, 8-10; Vocabulary E, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Demonstrate fluency in operations with real numbers, vectors and matrices, using mental computation or paper and pencil calculations for simple cases and technology for more complicated cases.* (Number D, 11-12)

BIL: Essential: ISS, NS, PSD, IM

EDU:	10	12	AD
ISS		I	P
NS		I	P
PSD		I	P
IM		I	P

Competency 48.7: Demonstrate knowledge of cost-benefit analysis

Descriptors:

- 48.7.1 Define cost and benefit analyses (NS, PSD, IM, ISS)
- 48.7.2 Differentiate between nonrecurring costs and recurring costs (IM, ISS)
- 48.7.3 Identify major cost categories (e.g., hardware, software, communication services, training, interface conversion) [IM, ISS]
- 48.7.4 Differentiate between tangible benefits and intangible benefits (IM, ISS)
- 48.7.5 Explain why intangible benefits are included in analyses (IM, ISS)
- 48.7.6 Identify tools used to rank and compare alternative costs and benefits (e.g., Net Present Value, Return on Investment, Discounted Payback Period) [ISS]
- 48.7.7 Execute full cost-benefit analysis (ISS)

BIL: **Essential:** **ISS, NS, PSD, IM**

EDU:	10	12	AD
ISS		I	P
NS		I	P
PSD		I	P
IM		I	P

Competency 48.8: Explain the vendor management process

Descriptors:

- 48.8.1 Define components of a RFP (Request for Proposals) [e.g., transmittal letter, instructions and procedures, and requirements and specifications] (NS, ISS, IM)
- 48.8.2 Identify basic criteria for vendor selection (NS, PSD, ISS, IM)
- 48.8.3 Identify common forms of vendor-buyer agreements (NS, ISS, IM)
- 48.8.4 Identify common problems in the vendor management process in the IT environment (e.g., compliance, confidentiality and non-disclosure) [NS, ISS, IM]