Digital Game Development Program of Study with Complementary Course Standards

This document was prepared by:

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Vision

All Nevada students are equipped and feel empowered to attain their vision of success

Mission

To improve student achievement and educator effectiveness by ensuring opportunities, facilitating learning, and promoting excellence

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Acknowledgements

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Business and Industry Validation

All CTE standards developed through the Nevada Department of Education are validated by business and industry through one or more of the following processes: (1) the standards are developed by a team consisting of business and industry representatives, or (2) a separate review panel is coordinated with industry experts to ensure the standards include the proper content, or (3) nationally recognized standards currently endorsed by business and industry.

The Digital Game Development standards were validated through active participation of business and industry representatives on the development team.

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Introduction

The standards in this document are designed to clearly state what the student should know and be able to do upon completion of a high school Digital Game Development program of study. These standards are designed for a two-credit course sequence that prepares the student for a technical assessment directly aligned to the standards.

These exit-level standards are designed for the student to complete all standards through their completion of a program of study. These standards are intended to guide curriculum objectives for a program of study.

The standards are organized as follows:

- **Content Standards** are general statements that identify major areas of knowledge, understanding, and the skills students are expected to learn in key subject and career areas by the end of the program.

- **Performance Standards** follow each content standard. Performance standards identify the more specific components of each content standard and define the expected abilities of students within each content standard.

- **Performance Indicators** are very specific criteria statements for determining whether a student meets the performance standard. Performance indicators may also be used as learning outcomes, which teachers can identify as they plan their program learning objectives. The indicators are followed by designations that reflect the course sequence (e.g., L1 for the first-year course of a two-year program and L2 for the second-year course, C is to designate the indicators to be taught in the complementary courses) as referenced in the Core Course Sequence table.

The crosswalks and alignments are located in the Program Supplemental Program Resources document. These will show where the performance indicators support the Nevada Academic Content Standards. For individual course descriptions, please reference the Supplemental Program Resource or the Nevada CTE Catalog.

All students are encouraged to participate in the career and technical student organization (CTSO) that relates to the Digital Game Development program. CTSOs are co-curricular national organizations that directly reinforce learning in the CTE classroom through curriculum resources, competitive events, and leadership development. CTSOs provide students the ability to apply academic and technical knowledge, develop communication and teamwork skills, and cultivate leadership skills to ensure college and career readiness.

The Employability Skills for Career Readiness identify the skills needed to be successful in all careers and must be taught as an integrated component of all CTE course sequences. These standards are available in a separate document.

The **Standards Reference Code** is only used to identify or align performance indicators listed in the standards to daily lesson plans, curriculum documents, or national standards. The Standards Reference Code is an abbreviated name for the program, and the content standard, performance standard and performance indicator are referenced in the program standards. This abbreviated code for identifying standards uses each of these items. For example, DGD is the Standards Reference Code for Digital Game Development. For Content Standard 2, Performance Standard 3 and Performance Indicator 4 the Standards Reference Code would be DGD.2.3.4.

Digital Game Development

Program Information

Program of Study:	Digital Game Development
Standards Reference Code:	DGD
Career Cluster:	Information Technology
Career Pathway(s):	Programming and Software Development
Program Length:	2-year, completed sequentially
CTSO:	FBLA/SkillsUSA

Program Structure Required Program of Study Courses

The core course sequencing is provided in the following table. Complementary Courses are available and provided later in this document. The following courses provide a completed program of study. The Lab is a complementary course available concurrently with the Digital Game Development II course.

Core Course Sequence (R) with Lab Course(s) (C)

Required/ Complementary	Course Title	Abbreviated Name
R	Digital Game Development I	DIG GAME DEV I
R	Digital Game Development II	DIG GAME DEV II
C	Digital Game Development II LAB	DIG GAME DEV II L

CONTENT STANDARD 1.0: INTEGRATE CAREER AND TECHNICAL STUDENT ORGANIZATIONS (CTSOs)

Performance Standard 1.1: Explore the History and Organization of CTSOs

1.1.1 Discuss the requirements of CTSO participation/involvement as described in Carl D. Perkins Law (Level 1 (L1), Level 2 (L2), Complementary (C))

1.1.2 Research nationally recognized CTSOs (L1, L2, C)

1.1.3 Investigate the impact of federal and state government regarding the progression and operation of CTSOs (e.g., Federal Statutes and Regulations, Nevada Administrative Code [NAC], Nevada Revised Statutes [NRS]) (L1, L2, C)

Performance Standard 1.2: Develop Leadership Skills

1.2.1 Discuss the purpose of parliamentary procedure (L1, L2, C)

1.2.2 Demonstrate the proper use of parliamentary procedure (L1, L2, C)

1.2.3 Differentiate between an office and a committee (L1, L2, C)

1.2.4 Discuss the importance of participation in local, regional, state, and national conferences, events, and competitions (L1, L2, C)

1.2.5 Participate in local, regional, state, or national conferences, events, or competitions (L1, L2, C)

1.2.6 Describe the importance of a constitution and bylaws to the operation of a CTSO chapter (L1, L2, C)

Performance Standard 1.3: Participate in Community Service

1.3.1 Explore opportunities in community service-related work-based learning (WBL) (L1, L2, C)

1.3.2 Participate in a service learning (program related) and/or community service project or activity (L1, L2, C)

1.3.3 Engage with business and industry partners for community service (L1, L2, C)

Performance Standard 1.4: Develop Professional and Career Skills

1.4.1 Demonstrate college and career readiness (e.g., applications, resumes, interview skills, presentation skills) (L1, L2, C)

1.4.2 Describe the appropriate professional/workplace attire and its importance (L1, L2, C)

1.4.3 Investigate industry-standard credentials/certifications available within this Career Cluster™ (L1, L2, C)

1.4.4 Participate in authentic contextualized instructional activities (L1, L2, C)

1.4.5 Demonstrate technical skills in various student organization activities/events (L1, L2, C)

Performance Standard 1.5: Understand the Relevance of Career and Technical Education (CTE)

1.5.1 Make a connection between program standards to career pathway(s) (L1, L2, C)

1.5.2 Explain the importance of participation and completion of a program of study (L1, L2, C)

1.5.3 Promote community awareness of local student organizations associated with CTE programs (L1, L2, C)

CONTENT STANDARD 2.0: CONTEXT OF DIGITAL GAME DEVELOPMENT

Performance Standard 2.1: Understand How Advances in Technology Impact Game Development

2.1.1   Explain the history of computing technologies that impact the game development industry (L1)

2.1.2   Explore non-digital games (L1)

2.1.3   Research the evolution of video games (L1)

2.1.4   Describe the different game genres (L1)

2.1.5   Evaluate contributions of individual game designers and developers (L1)

Performance Standard 2.2: Understand Careers in Game Design and Development

2.2.1   Explore careers in designing and developing interactive experiences (L1)

2.2.2   Research careers in non-interactive media using real-time game engines, including Architectural, Engineering and Construction (AEC), virtual production, architectural visualization, simulation, product/industrial design, and advertising (L1)

2.2.3   Describe career pathways in software engineering, quality assurance, and testing (L1)

2.2.4   Review roles of the producer, designer, art director, tech artist, and programmer (L1)

2.2.5   Explain the career path of an independent developer (L1)

2.2.6   Research labor market information in related industries (L1)

CONTENT STANDARD 3.0: FOUNDATIONS OF GAME DESIGN AND DEVELOPMENT

Performance Standard 3.1: Explain Fundamentals of Production

3.1.1   Explain the interdependence of team members between artistic, technical, and production disciplines (L1)

3.1.2   Outline the process of developing a game from concept to delivery and support (L1, L2)

3.1.3   Compare various types of collaboration tools, e.g., version control, shared storage, cloud services (L1, L2)

3.1.4   Explain the value of version control (L1, L2)

3.1.5   Explain the purpose of vertical slice (L2)

3.1.6   Discuss various optimization techniques (L2)

3.1.7   Describe good quality assurance practices (L2)

Performance Standard 3.2: Understand Game Structure

3.2.1   Explore the components of game structure (L1)

3.2.2   Analyze the essentials of storytelling, including visual and environmental story telling (L1)

3.2.3   Explain the characteristics of a nonlinear story (L1)

3.2.4   Create rules for a game, e.g., levels and/or interactive flow (L1)

3.2.5   Compare conflict and outcomes (L1)

3.2.6   Develop objectives and outcomes for a game (L1)

3.2.7   Explain the importance of usability and how it impacts user experience (L1, L2)

3.2.8   Explain in-game economies, motivators, and point systems (L1, L2)

Performance Standard 3.3: Game Documentation

3.3.1   Research various styles of game documentation (L1)

3.3.2   Develop a technical design document (TDD) (L1)

3.3.3   Develop components of a game design document (GDD) (L1)

3.3.4   Develop a list of required game assets (L1)

3.3.5   Produce a game design document (L2)

3.3.6   Produce a game pitch document (L2)

3.3.7   Present game documentation (L2)

Performance Standard 3.4: Industry Standard Game Mechanics

3.4.1   Compare categories of game mechanics (L1)

3.4.2   Research victory condition mechanics of a game (L1)

3.4.3   Discuss relationships between game mechanics, game play, and interactivity (L1)

3.4.4   Investigate what makes a game engaging, "fun," and playable to the user (L1)

CONTENT STANDARD 4.0: GAME DESIGN

Performance Standard 4.1: Understand Fundamentals of Design

    4.1.1   Evaluate the use of layout and composition (L1)

    4.1.2   Explain color theory (L1)

    4.1.3   Describe the principles of animation (L1)

    4.1.4   Describe the role of perspective (L1)

    4.1.5   Compare design considerations for environmental, assets, characters, and User Interface (UI) creation (L1, L2)

    4.1.6   Describe the characteristics and purposes of 2D, 2.5D, and 3D art (L1, L2)

    4.1.7   Evaluate the importance of artistic style and implement it with continuity (L1, L2)

Performance Standard 4.2: Design Levels

    4.2.1   Identify components of a level and its environment (L1)

    4.2.2   Compare processes of creating interior versus exterior environments (L1, L2)

    4.2.3   Compare level design of linear games to open world games (L1)

    4.2.4   Research terrains for a specific environment (L2)

    4.2.5   Discuss the concept of leveling up with increasing complexity (L2)

    4.2.6   Describe the impact of story (explicit, implicit, and emergent) on level design (L1)

    4.2.7   Explain the importance of flow, distance, timing, and choke points (L1)

    4.2.8   Storyboard levels including flow and choke points (L1, L2)

Performance Standard 4.3: Design Assets and Characters

    4.3.1   Investigate the twelve major character archetypes (L1, L2)

    4.3.2   Contrast architypes versus stereotypes as they relate to diversity and inclusion (L1, L2)

    4.3.3   Describe basic character backstory, strengths, and weaknesses (L1, L2)

    4.3.4   Explain the visual design of characters in relation to the "game feel" and artistic style (L1, L2)

    4.3.5   Describe the connection between character arc and character progression (L1, L2)

    4.3.6   Conceptualize and illustrate original game characters and assets (L1, L2)

    4.3.7   Examine the roles, purpose, and design of non-player characters (NPC) (L1, L2)

    4.3.8   Explain the difference in design between static and dynamic game objects, e.g., props, decorations versus characters, morphing objects (L1, L2)

    4.3.9   Detail the difference between organic and hard surfaces (L1, L2)

Performance Standard 4.4: Design Custom Mechanics

    4.4.1   Create a victory condition (L1)

    4.4.2   Assemble immersive elements into a game (L1, L2)

    4.4.3   Establish a reward system and in-game economics (L1, L2)

    4.4.4   Apply game mechanics to a game world (L1, L2)

    4.4.5   Balance and test game mechanics (L2)

CONTENT STANDARD 5.0: PROGRAMMING FOR DIGITAL GAME DEVELOPMENT

Performance Standard 5.1: Understand Logic in Game Development

5.1.1   Explain basic logic statements (e.g., if/then, cause/effect) (L1)

5.1.2   Explain the purpose and use of functions (L1)

5.1.3   Describe nested functions (L1)

5.1.4   Describe uses of Boolean operators and symbols associated with them (L1)

5.1.5   Demonstrate proper use of order of operations (L1)

5.1.6   Use logical thinking to create a diagram of code execution (L1)

5.1.7   Describe various types of loop structures used in programming (L1)

5.1.8   Describe the differences between compiled and interpreted code (L1, L2)

5.1.9   Explain methods for producing artificial intelligence (AI) to control Non-Playable Characters (NPC) (L1, L2)

5.1.10   Research design patterns in game programming (single, factory, and state) (L2)

Performance Standard 5.2: Explain Programming Language Concepts

5.2.1   Differentiate between syntax and semantics (L1)

5.2.2   Identify differences between compile and runtime errors (L1)

5.2.3   List primitive data types (L1)

5.2.4   Describe how arrays are used to store objects in a list (L1)

5.2.5   Demonstrate input from different sources (L1, L2)

5.2.6   Identify expected input and output of methods/functions (L1)

5.2.7   Explain the connection between visual programming and coding/scripting (L1)

5.2.8   Compare the use of constants and variables (L1)

5.2.9   Describe the implications of access modifiers (private/public, local/global) (L1)

5.2.10   Explore engine/programming documentation to understand available methods/functions (L2)

5.2.11   Describe object-oriented programming (OOP) (L1, L2)

Performance Standard 5.3: Utilize Programming in Game Development

5.3.1   Utilize code to modify objects based on collision detection and player activation (L1, L2)

5.3.2   Develop code or visual script that changes aspects of player movement (e.g., sprint, jump) (L1, L2)

5.3.3   Develop code or visual script that responds to a graphic user interface (GUI) input (e.g., user interface design (UI) button press (L1, L2)

5.3.4   Develop code or visual script that responds to hardware input (e.g., keyboard key or mouse press) (L1, L2)

5.3.5   Generate test cases and expected results (L2)

5.3.6   Format and display the value of a variable to a GUI (L1, L2)

5.3.7   Implement a basic point system for a game using visual scripting or code (L1, L2)

5.3.8   Verify game functionality through testing and debugging (12,22)

CONTENT STANDARD 6.0: BUILD A GAME

Performance Standard 6.1: Explore Various Development Environment and Best Practices Per Pipeline

6.1.1   Explain the characteristics and major components of game engines (render, compiler, editor) (L1)

6.1.2   Research various game engines for a software platform, target hardware, game style, or genre (L1)

6.1.3   Research supplemental tools necessary to create a specific development pipeline (L1)

6.1.4   Describe a complete game pipeline including the use of primary and supplemental tools and how they are used (L1)

6.1.5   Compare world scales between software tools (L2)

6.1.6   Describe considerations for importing and exporting assets (L2)

6.1.7   Define a standard directory structure and file naming conventions (L2)

Performance Standard 6.2: Develop Game Levels

6.2.1   Define the type, structure, and size of player environment (L1, L2)

6.2.2   Place and define non-player characters (NPC) into the environment (L1, L2)

6.2.3   Build boundaries, borders, and obstacles of levels within the game (L1, L2)

6.2.4   Place triggers and develop scripted events (12 22)

6.2.5   Create multiple levels for a game including start and closing screens and playable level(s) (L2)

Performance Standard 6.3: Utilize Graphical User Interface (GUI)

6.3.1   Research examples of GUI in digital and real-world environments (e.g., Heads Up Display [HUD] and road signs) (L1)

6.3.2   Define and implement required elements for various GUIs (L1)

6.3.3   Create flowcharts that map the GUIs' functionality (L1)

6.3.4   Design GUIs that use standard text, 2-D, and 3-D elements (buttons, progress bars, icons, etc.) (L1, L2)

Performance Standard 6.4: Use Animation in Game Development

6.4.1   Create storyboards for planning animations (L1)

6.4.2   Change an object's state or position over time (L1)

6.4.3   Establish an object's relative speed (timing versus frame rate) (L1)

6.4.4   Describe the difference between global time and local time (L2)

6.4.5   Describe the difference between forward and inverse kinematics (L2)

6.4.6   Examine the process of particle creation and its application to game design (L2)

6.4.7   Explain how joints, sockets, bones, and skins are used (L1, L2)

6.4.8   Create a parent/child hierarchy (L1, L2)

6.4.9   Simulate rigid body dynamics (e.g., shattering wall, breaking glass) (L2)

6.4.10 Animate game objects using triggers (L1, L2)

6.4.11 Describe the process of motion capture for animation (L1, L2)

6.4.12 Practice the use of cinematics and camera movements in game engines (L2)

Performance Standard 6.5: Integrate Various Media Types

6.5.1   Integrate different types of audio (e.g., sound effects, ambient background, dialogue, user experience design (UX), and score) (L1)

6.5.2   Practice creating triggers for sound, mixes, and/or loops (L1)

6.5.3   Determine acceptable media formats and files for game development (e.g., sound, graphics, video) (L1, L2)

6.5.4   Identify and import appropriate media into a game engine (L1, L2)

Performance Standard 6.6: Create Game Art

Performance Standard 6.6: Create Game Art

6.6.1   Explain the application of low polygon and high polygon construction for real-time environments (L1)

6.6.2   Create game assets from references and game design documents (GDD) (L1, L2)

6.6.3   Create hard surface and organic models using design principles (props or characters) (L1, L2)

6.6.4   Apply texturing/surfacing/shading/grudging to models and normal mapping (L1)

6.6.5   Render or produce a high-resolution screenshot from within a game engine (L1)

6.6.6   Real-time render a video, animated sequence or cutscene in a game engine (L1, L2)

6.6.7   Differentiate UVW mapping and world coordinate systems (L1)

6.6.8   Explain the importance of pre-baking lights and shadows for real-time interactive environments (L2)

6.6.9   Implement basic lighting for ambient and artificial light (L1, L2)

6.6.10 Create an environment including terrain, foliage and/or static objects (L2)

6.6.11 Create custom materials/shaders (L2)

6.6.12 Describe the use of Level of Detail (LOD) substitution, MIP mapping textures, and culling objects (L2)

CONTENT STANDARD 7.0: LEGAL AND ETHICAL ISSUES IN GAME DESIGN AND DEVELOPMENT

Performance Standard 7.1: Understand Legal Considerations in Game Development

   7.1.1   Research laws that govern intellectual property in diverse forms (L1)

   7.1.2   Evaluate Creative Commons and open-source licensure (L1)

   7.1.3   Explain copyright, trademark, and other intellectual property protection (L1)

   7.1.4   Identify key elements of non-disclosure agreements (NDA) and contracts (L2)

   7.1.5   Adhere to intellectual property laws and regulations and cite proprietary content and derivative works (L2)

   7.1.6   Explain Entertainment Software Rating Board (ESRB) and other rating systems for digital games (L1)

Performance Standard 7.2: Explain Security Issues in Relation to Game Development and Design

   7.2.1   Explain invasion of privacy in the use of technology (L2)

   7.2.2   Explore the issues of piracy and digital rights management (DRM) (L2)

   7.2.3   Model acceptable security practices (L2)

Performance Standard 7.3: Understand the Importance of Ethics, Diversity, and Inclusion

   7.3.1   Discuss diversity and inclusivity in games and the gaming industry (L1, L2)

   7.3.2   Discuss social responsibility and issues concerning video gaming (L1, L2)

CONTENT STANDARD 8.0: ADVANCED TOPICS IN DIGITAL GAME DEVELOPMENT

Performance Standard 8.1: Understand Social Aspects of Gaming

8.1.1   Describe integration of social components in a game (L2)

8.1.2   Explain the role of social media in the gaming community (L2)

8.1.3   Describe professional events in digital gaming (L2)

Performance Standard 8.2: Understand the Role of Networking

8.2.1   Summarize characteristics of cloud gaming (L2)

8.2.2   Evaluate the advances of multi-player gaming (L2)

Performance Standard 8.3: Explain Advances in Devices

8.3.1   Discuss trends in input devices (L2)

8.3.2   Examine current trends in output devices and displays (L2)

8.3.3   Explore advances in peripheral devices (L2)

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Complementary Courses

State Complementary Skill Standards

State complementary skill standards are designed to clearly state what the student should know and be able to do upon completion of a **one-year** complementary course related to their career and technical education (CTE) program of study. **Completion of the qualifying Program of Study is required prior to enrollment in a complementary course.**

Employability Skills for Career Readiness Standards

Students have completed all program content standards and will pursue advanced study through investigation and in-depth research.

Complementary Course Standards Contributing Members

Course Contribution(s)	Name	Occupation/Title	Stakeholder Affiliation	School/Organization
3D Animation	James Black	Instructor	Secondary Educator	Desert Pines High School, Clark County School District
3D Animation	Monte Carmon	Director and Instructor	Secondary Educator	Southwest Career and Technical Academy, Clark County School District
3DAnimation	Kevin Kirk	Instructor	Secondary Educator	Clark County High School, Clark County School District
3D Animation	Rory Olvina	CTE Strategist	Secondary Educator	Southwest Career and Technical Academy, Clark County School District
3D Animation	Ashley Stroud	Instructor	Secondary Educator	Las Vegas Academy of the Arts, Clark County School District
Software and App Development	Josiah Davisson	Instructor	Secondary Educator	Advanced Technologies Academy, Clark County School District
Software and App Development	Roger Mayo	Department Chair and Instructor	Secondary Educator	Advanced Technologies Academy, Clark County School District

Business and Industry Validation

All CTE standards developed through the Nevada Department of Education are validated by business and industry through one or more of the following processes: (1) the standards are developed by a team consisting of business and industry representatives, or (2) a separate review panel is coordinated with industry experts to ensure the standards include the proper content, or (3) nationally recognized standards currently endorsed by business and industry.

The 3D Animation, and Software and App Development complementary standards for Digital Game Development program of study were validated through active participation of business and industry representatives through the criticality survey.

Complementary Course Information for Digital Game Development

Program Information

Qualifying Program of Study:	**Digital Game Development**
Career Cluster:	**Information Technology**
Career Pathway(s):	**Programming and Software Development**
CTSO:	**FBLA/SkillsUSA**
Grade Level:	**11-12**

Program Structure for Complementary Courses

The complementary courses are provided in the following table. **The qualifying program of study must be completed prior to enrolling in the complementary courses** (except labs that are done concurrently with the second-year course). A program does not have to utilize the complementary courses for students to complete their program of study.

Complementary Courses

Required/ Complementary	Course Title	Abbreviated Name
C	3D Animation for Digital Game Development	3D ANIMATE DGD
C	Software and App Development for Digital Game Development	APP DEV DGD
C	Digital Game Development Advanced Studies	DIG GAME DEV AS
C	Industry-Recognized Credential – Digital Game Development	IRC DIG GAME DEV
C	CTE Work Experience – Information Technology	WORK EXPER IT

Complementary Course Standards
3D Animation

CONTENT STANDARD 1.0: THE FIELD OF ANIMATION

Performance Standard 1.1: Explain the Purposes and Uses of Animation

1.1.1   Research careers in animation

1.1.2   Describe trends in animation

1.1.3   Explain types of animation (i.e., traditional, stop motion, motion graphic, computer-generated imagery [CGI], and interface animation)

Performance Standard 1.2: Communicate Ideas Using Appropriate Industry Terminology

1.2.1   Formulate written communications using industry terminology

1.2.2   Practice verbal communication using industry terminology

1.2.3   Prepare and deliver a visual presentation utilizing appropriate industry terminology

Performance Standard 1.3: Apply the Animation Production Process

1.3.1   Summarize the general production process

1.3.2   Practice the production process

1.3.3   Manage production assets

1.3.4   Practice time management to meet production deadlines

1.3.5   Model fair use in production of animated works

CONTENT STANDARD 2.0: PRE-PRODUCTION

Performance Standard 2.1: Implement Concept Development Practices

2.1.1   Practice brainstorming and ideation to develop a concept

2.1.2   Conduct visual research to provide reference for a project

2.1.3   Produce thumbnails, roughs, and comprehensive layouts for presentation

2.1.4   Design and develop environments

2.1.5   Design and develop 3D animated assets and characters

Performance Standard 2.2: Demonstrate Knowledge of Visual Design

2.2.1   Apply the elements and principles of design

2.2.2   Apply the twelve principles of animation

2.2.3   Explain the role of visual language in an animation project

2.2.4   Apply the principles of animation to animated sequences

Performance Standard 2.3: Create Storyboards

2.3.1   Illustrate actions with sequential panels

2.3.2   Evaluate and revise storyboards for effectiveness and feasibility

2.3.3   Apply appropriate shot composition through camera placement

2.3.4   Describe appropriate shot composition for desired results

CONTENT STANDARD 3.0: 3D ANIMATION PRODUCTION

Performance Standard 3.1: Demonstrate Modeling Techniques

    3.1.1   Model objects using a variety of tools and techniques

    3.1.2   Conceptualize and utilize virtual 3D space

    3.1.3   Compare modeling methodologies (i.e., polygons, splines)

    3.1.4   Explain the application of low polygon and high polygon construction

    3.1.5   Modify and manipulate polygonal objects

Performance Standard 3.2: Apply Surface and Texture

    3.2.1   Modify and apply surface attributes

    3.2.2   Animate textures

    3.2.3   Create an original texture

    3.2.4   Identify UVW mapping coordinates

    3.2.5   Explain and create various mapping techniques

Performance Standard 3.3: Create and Apply Lighting

    3.3.1   Explain the properties and uses of different types of lights

    3.3.2   Create animated lighting

    3.3.3   Use three-point lighting in a project

    3.3.4   Compare and contrast indirect lighting and direct lighting

    3.3.5   Create environmental lighting

Performance Standard 3.4: Utilize Cinematography in Animation

    3.4.1   Create animated cameras

    3.4.2   Evaluate and select camera settings to achieve desired results

    3.4.3   Position multiple cameras to match an existing storyboard

Performance Standard 3.5: Apply Rigging to Models

    3.5.1   Describe the difference between forward and inverse kinematics

    3.5.2   Create a parent/child hierarchy

    3.5.3   Create a joint/bone chain

    3.5.4   Practice skinning models

    3.5.5   Apply and adjust weight maps

    3.5.6   Explain the use of constraints to animate objects

Performance Standard 3.6: Demonstrate Techniques of Motion

    3.6.1   Create and modify key frames and key poses

    3.6.2   Change an object's state or position over time

    3.6.3   Establish an object's relative speed

    3.6.4   Demonstrate an object following a path

    3.6.5   Simulate a naturally occurring or mechanical cycle (i.e., walking)

    3.6.6   Apply various animation techniques (i.e., pose-to-pose, straight ahead)

Performance Standard 3.7: Explore Dynamics in a Scene

    3.7.1   Explore atmospheric effects and particle systems

    3.7.2   Adjust the dynamic properties (i.e., gravity, wind speed)

    3.7.3   Simulate soft and rigid body dynamics

Performance Standard 3.8: Demonstrate Rendering Techniques

    3.8.1   Identify rendering types and purposes

    3.8.2   Apply appropriate rendering settings for a project

    3.8.3   Render a sequence of frames

CONTENT STANDARD 4.0: POST-PRODUCTION

Performance Standard 4.1: Create Final Output

    4.1.1   Demonstrate editing and compositing techniques

    4.1.2   Select and render appropriate format for distribution

    4.1.3   Conduct peer and self-evaluations using rubrics

Complementary Course Standards
Software and App Development

CONTENT STANDARD 1.0: COLLABORATIVE DEVELOPMENT

Performance Standard 1.1: Apply Software Development Lifecycle (SDLC)

    1.1.1   Describe the importance of the planning stage

    1.1.2   Compare various development methodologies (e.g., Agile, Waterfall, etc.)

    1.1.3   Apply appropriate methods for software/app development

    1.1.4   Explain industry specific terminology (e.g., Scrum, sprint, Ansible, Docker, etc.)

    1.1.5   Research the role of deployment tools and automation engines

    1.1.6   Test code for performance and scalability

    1.1.7   Check code for security flaws and vulnerabilities

    1.1.8   Apply SDLC to manage projects

Performance Standard 1.2: Utilize Source Control Systems

    1.2.1   Choose a source control system

    1.2.2   Manage repositories

    1.2.3   Explain branching and forking

    1.2.4   Utilize push and pull requests

    1.2.5   Handle merges and collisions

    1.2.6   Implement major and minor version controls

CONTENT STANDARD 2.0: TOOLS FOR DEVELOPMENT

Performance Standard 2.1: Evaluate Various Development Stacks

    2.1.1   Select and plan the appropriate stack for frontend and backend of a project

    2.1.2   Evaluate appropriate uses of various languages and databases

    2.1.3   Explain the use of programing libraries

    2.1.4   Explain the importance of dependencies

    2.1.5   Apply appropriate data structures and corresponding algorithms

Performance Standard 2.2: Create Databases

    2.2.1   Compare and evaluate different databases (e.g., Access, SQL, relational, no-SQL, etc.)

    2.2.2   Design and implement databases

    2.2.3   Perform basic database operations such as create, query, update, and delete records

Performance Standard 2.3: Utilize Application Programming Interface (API)

    2.3.1   Describe the concept of API in software development

    2.3.2   Explore and test popular API(s) used in industry

    2.3.3   Implement an API in a software application

    2.3.4   Create and document an API for an application

Performance Standard 2.4: Integrated Development Environment (IDE)

2.4.1   Explain the common features and uses of an IDE

2.4.2   Select and use an appropriate IDE

2.4.3   Explain the importance of software versions to an application

2.4.4   Use Software Development Kit (SDK) to develop and test applications

2.4.5   Research the impact of cloud computing on future IDE development

CONTENT STANDARD 3.0: DELIVERABLES AND QUALITY CONTROL

Performance Standard 3.1: Create Documentation

3.1.1   Create documentation for software and development projects

3.1.2   Use appropriate documentation tools and formats

3.1.3   Explain the importance of documentation in software and application development projects

3.1.4   Discuss the use of style guides in industry

Performance Standard 3.2: Apply User Testing and Revision Practices

3.2.1   Develop a testing plan for software and application development projects

3.2.2   Explain the role of dev vs. ops in application development workflows

3.2.3   Perform user testing

3.2.4   Revise software and app development projects based on user feedback

3.2.5   Document, track, and prioritize bugs and glitches

Performance Standard 3.3: Describe the Importance of Deliverables

3.3.1   Explain the rules and processes to publish an app through major distribution channels

3.3.2   Describe laws associated with publishing an app

3.3.3   Discuss the ethical implications of app development

CONTENT STANDARD 4.0: TOPICS IN PROGRAMING

Performance Standard 4.1: Develop and Maintain Portfolio

4.1.1   Conduct peer and self-evaluations using rubrics

4.1.2   Explain the importance of maintaining a portfolio for software development

4.1.3   Identify strategies for ongoing learning and growth

4.1.4   Discuss professional networking with social media

Performance Standard 4.2: Emerging Technologies in Computing

4.2.1   Research careers and advancements in data science

4.2.2   Compare traditional app development to the vendor "store" model

4.2.3   Describe the role of cloud computing in app development

4.2.4   Research applications of artificial intelligence (AI) and machine learning in various industries

4.2.5   Research the role low-code and no-code platforms have on future application development