Advanced Drawing and Design

8438 36 weeks

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The components of this instructional framework were reviewed by the following business panel team members:

Joshua Dale, Fire Protection Designer, VSC Fire & Security, Ashland
Melvin Fleming Jr., Senior Designer, Timmons Group, Richmond
Donnie Land, Regional CAD Coordinator, Kimley-Horn and Associates, Richmond
Danny MacNelly, Director, 3north Architects, Richmond
William Wooten, CAD Drafter, Whitman, Requardt & Associates, LLP, Richmond

The following teachers served on the Curriculum Development team:

Richard Aadahl, Lafayette High School, Williamsburg-James City County Public Schools
Barrett Airaghi, South Lakes High School, Fairfax County Public Schools

Terrance Beddow, Granby High School, Norfolk City Public Schools
Susan Chudovan, Chantilly Governor's STEM Academy, Fairfax County Public Schools
Douglas Kaltenbaugh, Oakton High School, Fairfax County Public Schools
James Kennedy, Heritage High School Governor's STEM Academy, Newport News Public Schools
Samuel Ketner, Atlee High School, Hanover County Public Schools
Erik Kittelson, Briar Woods High School, Loudoun County Public Schools
Maura Stout, Wilson Memorial High School, Augusta County Public Schools
Joseph Taylor, Wakefield High School, Arlington Public Schools

The framework was edited and produced by the CTE Resource Center:

Kevin P. Reilly, Administrative Coordinator
Robin A. Jedlicka, Writer/Editor

Dr. Lynn Basham, Specialist for Technology Education
Office of Career and Technical Education Services
Virginia Department of Education

B. Anne Rowe, CTE Career Cluster Coordinator
Office of Career and Technical Education Services
Virginia Department of Education

Lolita B. Hall, Director
Office of Career and Technical Education Services
Virginia Department of Education

Course Description

Suggested Grade Level: 11 or 12
Prerequisites: 8436 or 8437

Students use a graphic language for product design and technical illustration. They increase their understanding of drawing techniques learned in the prerequisite courses. They research design-related fields while identifying the role of advanced drawing and design in manufacturing and construction industry processes. They apply the design process, analyze design solutions, reverse engineer products, create 3-D solid models using CAD, construct physical models, and create multimedia presentations of finished designs. They complete a work portfolio based on a chosen graphic project.

Task Essentials Table

- Tasks/competencies designated by plus icons (⊕) in the left-hand column(s) are essential
- Tasks/competencies designated by empty-circle icons (○) are optional
- Tasks/competencies designated by minus icons (⊖) are omitted
- Tasks marked with an asterisk (*) are sensitive.

Task Number	8438	Tasks/Competencies
Focusing on Design		
39	⊕	Research design-related fields.
40	⊕	Identify advanced drawing and design terminology.
41	⊕	Explain the engineering design process.
42	⊕	Analyze design solutions.
43	⊕	Implement a design process needed to complete a design solution.
44	⊕	Prepare freehand preliminary sketches.
45	⊕	Develop skills related to using scale.
46	⊕	Develop measuring skills.
47	⊕	Analyze a 3-D design model.
48	⊕	Analyze multi-drawing sets.
49	⊕	Present design ideas.
50	⊕	Reverse engineer products.
51	⊕	Construct physical models of designs.
52	⊕	Develop blueprint reading skills.
Focusing on Drawing		
53	⊕	Generate multi-view orthographic projections from a 3-D design model.
54	○	Generate specification schedules.

55	⊕	Render presentation designs.	
56	⊕	Generate sectional views.	
57	⊕	Create 3-D solid models using CAD.	
58	⊕	Design parts and assembly drawings using coordinate systems.	
59	⊕	Create working drawings and sheet sets.	
60	⊕	Dimension drawings, according to the standards of ANSI (American National Standards Institute), ISO (International Standards Organization), and NCS (National CAD Standards).	
61	⊕	Create layered multi-view, multi-scale drawings.	
62	○	Demonstrate the use and manipulation of styles.	
Focusing on Documentation			
63	○	Develop specification data.	
64	⊕	Use technical writing style in documentation.	
65	○	Create a multimedia presentation of a finished design, incorporating animation files.	
66	⊕	Investigate inventive methods of documentation.	
67	⊕	Justify calculations and assumptions made during the design process.	
Maintaining Professionalism			
68	⊕	Adhere to prescribed guidelines regarding equipment use, Internet use, personal conduct, and agency regulations.	
69	⊕	Describe ethical issues in the design industry.	
70	⊕	Identify the role of advanced drawing and design in manufacturing and construction industry processes.	
71	⊕	Characterize what collaboration is necessary between the design trades/fields.	
72	○	Present a complete work portfolio.	

Legend: ⊕Essential ○Non-essential ⊖Omitted

Curriculum Framework

Focusing on Design

Task Number 39

Research design-related fields.

Definition

Research should include

- comparison of careers within fields
- colleges that offer design-related programs of study
- employment requirements (education, licenses, certifications, credentials)
- career prospects (on national, state, and local levels)
- professional expectations (compensation, work environment, personal issues, advancement)
- community interaction.

Process/Skill Questions

- What are some components of a portfolio that would highlight your work in Advanced Drawing and Design?
- What is included in a typical compensation package?
- How might a professional demonstrate his or her credentials and achievements in a business meeting?
- What are the credentials, certifications, licenses, and/or educational requirements for a specific job opening?
- How is the safety of others a professional concern in the field of drawing and design?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

8. The Attributes of Design

TSA Competitive Events

Biotechnology Design

Career Preparation

Engineering Design

Prepared Presentation

Technology Bowl (Written and Oral)

Video Game Design

Webmaster

Task Number 40

Identify advanced drawing and design terminology.

Definition

Identification should include terms in the following areas:

- Design
- Drawing
- Design process
- Drawing tools
- Computer-aided design (CAD)
- Construction
- Manufacturing
- Engineering
- Architecture (commercial and residential)
- Reverse engineering
- Building information modeling (BIM)

Process/Skill Questions

- What are some examples of ethical dilemmas one might face in engineering and architectural design?
- What impact does architectural drawing have on construction?

- What are flowcharts?
- How do standards influence various forms of engineering?
- What are the different forms of engineering?
- What are working drawings?
- How do working drawings differ in various forms of engineering?

ITEEA National Standards

12. Use and Maintain Technological Products and Systems

TSA Competitive Events

Animatronics

Architectural Renovation

Computer Numerical Control Production

Computer-Aided Design (CAD)-Architecture 2D

Computer-Aided Design (CAD)-Engineering 3D

Engineering Design

Manufacturing Prototype

Scientific and Technical Visualization (SciVis)

Structural Engineering

System Control Technology

Technical Sketching and Application

Technology Bowl (Written and Oral)

Transportation Modeling

Task Number 41

Explain the engineering design process.

Definition

Explanation of the engineering design process should include the following steps:

- Identify the need or opportunity for an engineering solution.
- Define an engineering design problem.
- Identify the requirements and constraints of the design problem.
- Research potential solutions to the design problem.
- Generate (brainstorm) multiple solutions to the design problem.
- Sketch the solutions to the design problem.
- Evaluate the requirements and constraints of each solution to the design problem.
- Justify an optimal solution to the design problem.
- Create a model or prototype for the chosen solution to the design problem, using appropriate materials and processes.
- Determine the objectives for an engineering test of the solution to the design problem.
- Test the solution to the design problem, using mathematical, conceptual, and/or physical modeling, simulating, and optimizing.
- Evaluate the test results.
- Formulate an alternate solution to the design problem, if needed.
- Test the alternate solution, if needed.
- Present the final project report.
- Document the final project report.

Process/Skill Questions

- Why is it important to follow a systematic design process?
- Why is it important to repeat the steps of the design process?
- When is necessary to refine the design?

ITEEA National Standards

11. Apply the Design Processes

9. Engineering Design

TSA Competitive Events

Animatronics

Architectural Renovation

Biotechnology Design

Computer-Aided Design (CAD)-Architecture 2D

Computer-Aided Design (CAD)-Engineering 3D

Engineering Design

Manufacturing Prototype

Scientific and Technical Visualization (SciVis)

Structural Engineering

System Control Technology

Technology Problem Solving

Transportation Modeling

Video Game Design

Task Number 42

Analyze design solutions.

Definition

Analysis should include

- annotations
- constraints
- function
- quality control
- critiques (made by self, jury, community, superior, or instructor)
- aesthetic quality
- spatial plan.

Process/Skill Questions

- What are some of the criteria used to evaluate successful design?
- What guidelines should be followed to evaluate the design success?
- Who passes final judgment on the success of the design implementation?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

11. Apply the Design Processes

13. Assess the Impact of Products and Systems

8. The Attributes of Design

9. Engineering Design

TSA Competitive Events

Architectural Renovation

Computer Numerical Control Production

Computer-Aided Design (CAD)-Architecture 2D

Computer-Aided Design (CAD)-Engineering 3D

Engineering Design

Manufacturing Prototype

Scientific and Technical Visualization (SciVis)

Structural Engineering

System Control Technology

Technical Sketching and Application

Technology Problem Solving

Transportation Modeling

Video Game Design

Task Number 43

Implement a design process needed to complete a design solution.

Definition

Design process should include

- general understanding of the problem, including constraints
- brainstorming ideas
- sketching ideas and solutions
- producing necessary technical drawings and documentation
- producing working drawings
- evaluating and analyzing final design
- maintaining a design portfolio.

Process/Skill Questions

- What are some different forms of documentation used in the design process?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

11. Apply the Design Processes

8. The Attributes of Design

9. Engineering Design

TSA Competitive Events

Computer Numerical Control Production

Engineering Design

Fashion Design

Technical Sketching and Application

Technology Problem Solving

Task Number 44

Prepare freehand preliminary sketches.

Definition

Preparation of sketches should include

- pictorial views
- evolution of design
- thumbnails
- selection of necessary views
- proportions
- design notes (justification, philosophy, reasoning).

Process/Skill Questions

- What are some everyday products that are produced from designs?
- What are transition pieces?
- How does geometry play a role in developing designs?
- What pictorial drawings would be produced by an engineer? An architect?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

11. Apply the Design Processes

8. The Attributes of Design

TSA Competitive Events

Architectural Renovation

Engineering Design

Manufacturing Prototype

Structural Engineering

Technical Sketching and Application

Technology Problem Solving

Task Number 45

Develop skills related to using scale.

Definition

Development should include skills in

- overall drawing scale
- individual scale of views.

Process/Skill Questions

- How can the scale of your drawing affect its readability?
- Why are architectural drawings typically set to a scale in which 1/8th inch equals one foot?
- Why are detailed drawings set at a larger scale?

ITEEA National Standards

11. Apply the Design Processes

TSA Competitive Events

Architectural Renovation

Computer-Aided Design (CAD)-Architecture 2D

Technical Sketching and Application

Task Number 46

Develop measuring skills.

Definition

Development of measuring skills should include

- proper implementation of tolerances
- conversion between units
- conversion between systems of measurement
- use of different types of scale (e.g., Metric, Society of Automotive Engineers).

Process/Skill Questions

- How does the implementation of tolerances affect interchangeable parts in manufacturing?
- How were the two systems of measurement responsible for the crash of the Mars Climate Orbiter in 1999?
- Which scales are used predominantly in which professions?

ITEEA National Standards

11. Apply the Design Processes

12. Use and Maintain Technological Products and Systems

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

TSA Competitive Events

Architectural Renovation

Computer-Aided Design (CAD)-Architecture 2D

Computer-Aided Design (CAD)-Engineering 3D

Dragster Design

Fashion Design

Manufacturing Prototype

Structural Engineering

Technical Sketching and Application

Task Number 47

Analyze a 3-D design model.

Definition

Analysis of an object should include

- dimensions
- specifications
- proportions
- spatial relationships
- interferences.

Process/Skill Questions

- What measurements are needed to create a proportional drawing (enlargement or reduction) of an object?
- How do the geometric components of a model manifest design concerns?
- What are some of the outcomes of spatial relationships?
- How can analyzing interference in a 3-D assembly save money?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

11. Apply the Design Processes

8. The Attributes of Design

9. Engineering Design

TSA Competitive Events

Architectural Renovation

Computer Numerical Control Production

Computer-Aided Design (CAD)-Architecture 2D

Computer-Aided Design (CAD)-Engineering 3D

Manufacturing Prototype

Scientific and Technical Visualization (SciVis)

Technology Problem Solving

Task Number 48

Analyze multi-drawing sets.

Definition

Analysis should include

- interferences
- fit and function
- system compatibility.

Process/Skill Questions

- Why is scale (scaling) important in multi-view drawings?
- What types of products/designs might necessitate multi-view drawings?
- Why are there standard symbols and lines in multi-view drawings?
- What drawings are typically included in a set of construction documents for a house?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

11. Apply the Design Processes

8. The Attributes of Design

9. Engineering Design

TSA Competitive Events

Architectural Renovation

Engineering Design

Manufacturing Prototype

Scientific and Technical Visualization (SciVis)

Structural Engineering

Technical Sketching and Application

Transportation Modeling

Task Number 49

Present design ideas.

Definition

Presentation should include

- visual aids
- clear description of solution
- use of multimedia
- proper documentation and selection of drawings.

Process/Skill Questions

- What is the best way to present a new architectural design?
- What is the best way to present a working 3-D internal combustion engine?

ITEEA National Standards

11. Apply the Design Processes

12. Use and Maintain Technological Products and Systems

17. Information and Communication Technologies

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

8. The Attributes of Design

9. Engineering Design

TSA Competitive Events

Architectural Renovation

Career Preparation

Computer-Aided Design (CAD)-Architecture 2D

Computer-Aided Design (CAD)-Engineering 3D

Engineering Design

Fashion Design

Manufacturing Prototype

Prepared Presentation

System Control Technology

Video Game Design

Task Number 50

Reverse engineer products.

Definition

Reverse engineering should include the following steps:

- Analyze the product (throughout the process).
- Disassemble the product.
- Measure the parts and assembly.
- Create a series of working drawings.
- Improve the product.

Process/Skill Questions

- Why is dimensioning important in reverse engineering?
- Why are multi-view drawings necessary in reverse engineering?
- Why are constant evaluation and updating ultimately beneficial to product refinement?
- Why might a company decide to redesign or improve a product?

ITEEA National Standards

1. The Characteristics and Scope of Technology

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

11. Apply the Design Processes

12. Use and Maintain Technological Products and Systems

13. Assess the Impact of Products and Systems

8. The Attributes of Design

9. Engineering Design

TSA Competitive Events

Architectural Renovation

Computer Numerical Control Production

Engineering Design

Manufacturing Prototype

System Control Technology

Technology Problem Solving

Task Number 51

Construct physical models of designs.

Definition

Construction should include

- determination of the model scale
- selection of appropriate building materials
- safe use of tools.

Process/Skill Questions

- What are some benefits of constructing models of a building or an assembly?
- How does constructing a model help the design process?
- How can an architect or engineer improve quality of life through his or her design?
- How has 3-D printing revolutionized fabrication in industry?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

8. The Attributes of Design

9. Engineering Design

TSA Competitive Events

Architectural Renovation

Computer Numerical Control Production

Dragster Design

Engineering Design

Flight Endurance

Manufacturing Prototype

Scientific and Technical Visualization (SciVis)

Structural Engineering

System Control Technology

Transportation Modeling

Task Number 52

Develop blueprint reading skills.

Definition

Blue print reading skills should include

- effective annotations
- drawing atmosphere, such as
    - Line weights
    - Line types
    - Hatches
    - Symbols
- scales
- inclusion of necessary drawings and details.

Process/Skill Questions

- What qualities make up an effective blueprint notation?
- What are some of the standard drawings included in a set of construction documents?
- What is the view plane for a floor-plan drawing?

ITEEA National Standards

11. Apply the Design Processes

12. Use and Maintain Technological Products and Systems

8. The Attributes of Design

9. Engineering Design

TSA Competitive Events

Architectural Renovation

Computer Numerical Control Production

Computer-Aided Design (CAD)-Architecture 2D

Computer-Aided Design (CAD)-Engineering 3D

Engineering Design

Manufacturing Prototype

Scientific and Technical Visualization (SciVis)

Focusing on Drawing

Task Number 53

Generate multi-view orthographic projections from a 3-D design model.

Definition

Generation of multi-view orthographic projections should include

- rationale for choices of views
- required number of views to fully describe object
- a reference view
- symbols (e.g., centerlines, hidden lines, section lines, cutting-plane lines, materials)
- appropriate references
- appropriate scale
- dimension conventions.

Process/Skill Questions

- What justifies a sectional-view drawing?
- How do you choose where the sectional cutting-plane line passes?
- What determines the scale of a sectional view?
- When is a sectional view necessary?
- What is the difference between first- and third-angle projections?
- Where are first- and third-angle projections used?
- How is the front view of an object determined?
- How can the number of views be reduced and still fully describe an object?
- When do you need more than three views?
- How do you know how to space the views?
- How do you determine the proper scale?
- What are projection lines?

ITEEA National Standards

11. Apply the Design Processes

8. The Attributes of Design

TSA Competitive Events

Architectural Renovation

Computer Numerical Control Production

Computer-Aided Design (CAD)-Architecture 2D

Computer-Aided Design (CAD)-Engineering 3D

Manufacturing Prototype

Scientific and Technical Visualization (SciVis)

Technical Sketching and Application

Task Number 54

Generate specification schedules.

Definition

Generation of specification schedules should include

- tables
- part numbers
- source
- materials
- codes and references
- building specifications (for architectural schedules)
- properties.

Process/Skill Questions

- What should be included in a specification schedule?
- What is a parts list?
- Why are materials identified for production?
- Why is it important to follow building codes?

- Where do building codes originate?
- What organizations determine building codes?
- What is an example of a local building code?
- How are building codes enforced?
- What are the differences between home covenants, city ordinances, and building codes?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

11. Apply the Design Processes

8. The Attributes of Design

9. Engineering Design

TSA Competitive Events

Architectural Renovation

Computer Numerical Control Production

Engineering Design

Manufacturing Prototype

Scientific and Technical Visualization (SciVis)

Technical Sketching and Application

Task Number 55

Render presentation designs.

Definition

Rendering should include

- lighting
- colors
- shadowing

- finishes
- backgrounds
- building materials (for architectural designs)
- walk-through (for architectural designs).

Process/Skill Questions

- What is the difference between line and shade rendering?
- How do color and texture impact drawings? Finishes? Backgrounds?
- What is the difference between a technical drawing and an illustration?
- What determines the type of view in which the rendering is created?
- When would you use one-, two-, and three-point perspectives?
- How do colors, finishes, and textures impact presentations?
- What file type is most appropriate for digital presentations?
- How are digital graphic presentation files edited?

ITEEA National Standards

11. Apply the Design Processes

8. The Attributes of Design

TSA Competitive Events

Architectural Renovation

Engineering Design

Essays on Technology

Prepared Presentation

Promotional Graphics

Scientific and Technical Visualization (SciVis)

Technical Sketching and Application

Task Number 56

Generate sectional views.

Definition

Generation of sectional views should include

- a reference view
- symbols (plane lines, phantom lines, section lines, material)
- reference text
- cutting-plane lines
- dimensions and scale
- rationale.

Process/Skill Questions

- What is the difference between line and shade rendering?
- What justifies a sectional-view drawing?
- How do you choose where the sectional cutting-plane line passes?
- What determines the scale of a sectional view?
- What are the types of sections and an example of each?
- When are hidden lines used?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

11. Apply the Design Processes

8. The Attributes of Design

9. Engineering Design

TSA Competitive Events

Architectural Renovation

Computer-Aided Design (CAD)-Architecture 2D

Computer-Aided Design (CAD)-Engineering 3D

Manufacturing Prototype

Scientific and Technical Visualization (SciVis)

Transportation Modeling

Task Number 57

Create 3-D solid models using CAD.

Definition

Creating solid models should include

- interpreting specifications
- sketching
- applying feature and dimensional constraints
- use of modeling features
- generating dimensions and text
- geometry
- solar analysis (for architectural models).

Process/Skill Questions

- Why is it beneficial to create computer models before creating drawings of designs?
- How do you determine the scale for a solid model?
- How do you export solid-model files?
- How do you prepare a solid model for a 3-D printer?
- How are feature and dimensional constraints applied?
- How are specifications created?
- How do you generate orthographic views from a solid model?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

11. Apply the Design Processes

8. The Attributes of Design

9. Engineering Design

TSA Competitive Events

Architectural Renovation

Computer Numerical Control Production

Computer-Aided Design (CAD)-Architecture 2D

Computer-Aided Design (CAD)-Engineering 3D

Engineering Design

Manufacturing Prototype

Scientific and Technical Visualization (SciVis)

Technology Problem Solving

Task Number 58

Design parts and assembly drawings using coordinate systems.

Definition

Design of parts and drawings should be developed using appropriate coordinate systems.

Process/Skill Questions

- What are the most common coordinate systems?
- What are the benefits and limitations for each of the common coordinate systems?
- Why is it necessary to show the path of the assembly? How things fit?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

11. Apply the Design Processes

8. The Attributes of Design

9. Engineering Design

TSA Competitive Events

Computer Numerical Control Production

Computer-Aided Design (CAD)-Architecture 2D

Computer-Aided Design (CAD)-Engineering 3D

Engineering Design

Scientific and Technical Visualization (SciVis)

Technical Sketching and Application

Task Number 59

Create working drawings and sheet sets.

Definition

Creation of working drawings and sheet sets should include

- index of sheet sets
- title blocks
- scale
- assembly view(s) with balloons and a parts list
- true views
- construction documents (for architectural drawings and sheet sets)
- all written and visual information necessary to construct the object accurately.

Process/Skill Questions

- What are the basic standards for a finished set of drawings? What must a finished set include?
- Why are sheet sets in a systematic order?
- What is the purpose of design notes?

ITEEA National Standards

11. Apply the Design Processes

8. The Attributes of Design

TSA Competitive Events

Computer Numerical Control Production

Computer-Aided Design (CAD)-Architecture 2D

Computer-Aided Design (CAD)-Engineering 3D

Scientific and Technical Visualization (SciVis)

Technical Sketching and Application

Task Number 60

Dimension drawings, according to the standards of ANSI (American National Standards Institute), ISO (International Standards Organization), and NCS (National CAD Standards).

Definition

Dimensioned drawings should include

- location dimensions
- size dimensions
- minimum number of dimensions to construct the object accurately
- architectural or engineering style.

Process/Skill Questions

- What is the purpose of dimensioning a solid model?
- How are architectural or engineering objects dimensioned?
- How can you manage manufacturing errors through dimensioning?
- How do you determine where dimensions are placed?
- How do you determine the most appropriate dimensioning style?

ITEEA National Standards

11. Apply the Design Processes

8. The Attributes of Design

TSA Competitive Events

Computer Numerical Control Production

Engineering Design

Manufacturing Prototype

Scientific and Technical Visualization (SciVis)

Technical Sketching and Application

Task Number 61

Create layered multi-view, multi-scale drawings.

Definition

Creation of drawings should include

- hidden viewports
- independently scaled viewports, as necessary
- standard scales
- layer management strategies (e.g., locking, freezing, adjusting settings).

Process/Skill Questions

- What standard scales are used for architecture?
- How are viewports used to enhance drawings?
- What is the advantage of using CAD strategies such as locking and freezing?

ITEEA National Standards

11. Apply the Design Processes

8. The Attributes of Design

TSA Competitive Events

Architectural Renovation

Computer Numerical Control Production

Computer-Aided Design (CAD)-Architecture 2D

Computer-Aided Design (CAD)-Engineering 3D

Engineering Design

Manufacturing Prototype

Scientific and Technical Visualization (SciVis)

Structural Engineering

Technical Sketching and Application

Technology Problem Solving

Task Number 62

Demonstrate the use and manipulation of styles.

Definition

Demonstration should include using and manipulating

- text characteristics (e.g., size, font, color)
- dimension characteristics (e.g., sizes, scales, features, units)
- table characteristics (e.g., units, colors, formulas)
- materials (e.g., surface textures, transparency, reflectivity)
- scene appearance (e.g., background, hand drawn vs. CAD, line weight and jitter, shadow display, texture display).

Process/Skill Questions

- How are the appearances of dimensions controlled with varying scales?
- What is the advantage of having multiple styles/families?
- What is the effect of changing a style or family?
- How can the use of styles provide control over existing entities?
- How can the use of styles enhance multi-scale drawings?
- How can the use of styles affect renderings?

ITEEA National Standards

11. Apply the Design Processes

8. The Attributes of Design

9. Engineering Design

TSA Competitive Events

Computer-Aided Design (CAD)-Architecture 2D

Computer-Aided Design (CAD)-Engineering 3D

Engineering Design

Scientific and Technical Visualization (SciVis)

Technical Sketching and Application

Focusing on Documentation

Task Number 63

Develop specification data.

Definition

Development of data should specify

- project data
- references
- materials
- parts list
- colors
- codes
- dimensions and tolerances
- quantities.

Process/Skill Questions

- What is the benefit of having a materials list?
- Why are parts lists necessary?
- What do building codes determine, and how do they affect design choices?
- Why is it important to specify dimensions and tolerances on drawings?
- How do design constraints affect specifications?

ITEEA National Standards

11. Apply the Design Processes

8. The Attributes of Design

TSA Competitive Events

Animatronics

Architectural Renovation

Computer Numerical Control Production

Computer-Aided Design (CAD)-Architecture 2D

Computer-Aided Design (CAD)-Engineering 3D

Engineering Design

Essays on Technology

Manufacturing Prototype

Scientific and Technical Visualization (SciVis)

Structural Engineering

System Control Technology

Technical Sketching and Application

Technology Problem Solving

Transportation Modeling

Video Game Design

Task Number 64

Use technical writing style in documentation.

Definition

Use of technical writing style should include attention to

- grammar
- usage
- content
- conciseness
- spelling.

Process/Skill Questions

- What is the difference between expository writing and technical writing?
- What is slang?
- Why are spelling, sentence structure, correct grammar, and precise usage crucial in technical writing?

ITEEA National Standards

11. Apply the Design Processes

8. The Attributes of Design

TSA Competitive Events

Engineering Design

Essays on Technology

Manufacturing Prototype

System Control Technology

Technical Sketching and Application

Task Number 65

Create a multimedia presentation of a finished design, incorporating animation files.

Definition

Creation of the multimedia presentation should include

- a storyboard
- various manipulated images
- audio element(s) (e.g., music, narration, sound effects)
- transitions
- CAD solid models
- movie(s) or still clip(s)
- "walk-through" or "fly-about" animation(s)
- a title
- support documentation
- credits.

Process/Skill Questions

- Why is visualization in multimedia important?
- Why is it important to develop a storyboard before developing a presentation?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

11. Apply the Design Processes

13. Assess the Impact of Products and Systems

17. Information and Communication Technologies

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

4. The Cultural, Social, Economic, and Political Effects of Technology

6. The Role of Society in the Development and Use of Technology

8. The Attributes of Design

9. Engineering Design

TSA Competitive Events

Computer-Aided Design (CAD)-Architecture 2D

Computer-Aided Design (CAD)-Engineering 3D

Desktop Publishing

Digital Video Production

Engineering Design

Essays on Technology

Prepared Presentation

Promotional Graphics

Scientific and Technical Visualization (SciVis)

Technical Sketching and Application

Technology Bowl (Written and Oral)

Video Game Design

Task Number 66

Investigate inventive methods of documentation.

Definition

Investigation of documentation methods should include

- examples of real-world product documents
- software
- 3-D technology.

Process/Skill Questions

- What methods are available to document a product other than the traditional paper method?
- What software is currently used in industry to represent design details?
- How can 3-D technology make it easier to understand and visualize how a product is put together?

ITEEA National Standards

11. Apply the Design Processes

17. Information and Communication Technologies

TSA Competitive Events

Computer-Aided Design (CAD)-Engineering 3D

Desktop Publishing

Engineering Design

Task Number 67

Justify calculations and assumptions made during the design process.

Definition

Justification of calculations and assumptions should include

- examples of research of similar design problems and solutions to obtain supporting data
- software simulation of material/structural testing
- use of the design process model
- mathematical calculations of specific materials used.

Process/Skill Questions

- Why is it important to provide information to justify production decisions?
- What are the steps in the design process model?
- What external forces or conditions would affect your design?
- What has made similar designs succeed or fail, and how does your design compare?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

11. Apply the Design Processes

17. Information and Communication Technologies

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

9. Engineering Design

TSA Competitive Events

Computer-Aided Design (CAD)-Architecture 2D

Computer-Aided Design (CAD)-Engineering 3D

Engineering Design

Technical Sketching and Application

Maintaining Professionalism

Task Number 68

Adhere to prescribed guidelines regarding equipment use, Internet use, personal conduct, and agency regulations.

Definition

Demonstration should include identification of and adherence to

- manufacturers' instructions regarding hardware, electricity, and cabling

- software licensing procedures
- guidelines for Internet use
- guidelines for networking and file sharing
- standards of professional conduct
- governmental and other agency regulations.

Process/Skill Questions

- What are the reasons for following manufacturers' instructions?
- What might be the consequences of not following guidelines for Internet use?
- What is meant by “professional” conduct?
- Why must everyone know and follow governmental and other agency regulations?

ITEEA National Standards

12. Use and Maintain Technological Products and Systems

13. Assess the Impact of Products and Systems

4. The Cultural, Social, Economic, and Political Effects of Technology

6. The Role of Society in the Development and Use of Technology

TSA Competitive Events

Essays on Technology

Extemporaneous Presentation

Prepared Presentation

Technology Bowl (Written and Oral)

Task Number 69

Describe ethical issues in the design industry.

Definition

Description should include issues such as

- copyright

- property rights
- honesty
- theft
- plagiarism.

Process/Skill Questions

- Why is copyright an issue in the drawing and design industry?
- What is plagiarism?
- What is intellectual property?

ITEEA National Standards

1. The Characteristics and Scope of Technology

13. Assess the Impact of Products and Systems

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

4. The Cultural, Social, Economic, and Political Effects of Technology

6. The Role of Society in the Development and Use of Technology

7. The Influence of Technology on History

8. The Attributes of Design

TSA Competitive Events

Career Preparation

Debating Technological Issues

Essays on Technology

Extemporaneous Presentation

Prepared Presentation

Technology Bowl (Written and Oral)

Task Number 70

Identify the role of advanced drawing and design in manufacturing and construction industry processes.

Definition

Identification of the contributions that the drawing and design field makes to the manufacturing and construction industries should include

- increases environmental efficiencies
- influences cultural expression and identity
- affects social issues
- helps the economy
- provides solutions to political issues
- increases efficiency and precision.

Process/Skill Questions

- What is green technology?
- What is green architecture?
- How do social issues affect design?
- How does design affect efficiency (i.e., energy use)?
- What are some job titles in the field of drawing and design?

ITEEA National Standards

1. The Characteristics and Scope of Technology

13. Assess the Impact of Products and Systems

19. Manufacturing Technologies

2. The Core Concepts of Technology

20. Construction Technologies

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

4. The Cultural, Social, Economic, and Political Effects of Technology

6. The Role of Society in the Development and Use of Technology

7. The Influence of Technology on History

8. The Attributes of Design

9. Engineering Design

TSA Competitive Events

Career Preparation

Essays on Technology

Extemporaneous Presentation

Prepared Presentation

Technical Sketching and Application

Technology Bowl (Written and Oral)

Task Number 71

Characterize what collaboration is necessary between the design trades/fields.

Definition

Characterization of collaboration efforts should include

- commonly used terms
- understanding of materials
- determining available fabrication procedures
- general permit and legal responsibilities
- relationship dynamics between trades/fields.

Process/Skill Questions

- What is participatory design?
- What technology is available for real-time design collaboration?
- How does communication affect a project team?
- What values need to be established in order for collaboration to be successful?

ITEEA National Standards

11. Apply the Design Processes

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

TSA Competitive Events

Architectural Renovation

Computer-Aided Design (CAD)-Architecture 2D

Computer-Aided Design (CAD)-Engineering 3D

Engineering Design

Scientific and Technical Visualization (SciVis)

Structural Engineering

Task Number 72

Present a complete work portfolio.

Definition

Presentation should include

- multimedia (hard copy and digital) elements
- résumé
- 2-D and 3-D models
- sheet sets
- working drawings
- renderings of solid models
- storyboards
- freehand sketches.

Process/Skill Questions

- What constitutes a set of working drawings?
- What portfolio format options are available?

- What is authorship/ownership, and how does it affect elements of a design portfolio?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

11. Apply the Design Processes

13. Assess the Impact of Products and Systems

17. Information and Communication Technologies

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

4. The Cultural, Social, Economic, and Political Effects of Technology

6. The Role of Society in the Development and Use of Technology

8. The Attributes of Design

9. Engineering Design

TSA Competitive Events

Career Preparation

Essays on Technology

Extemporaneous Presentation

Prepared Presentation

Technology Bowl (Written and Oral)

SOL Correlation by Task

39	Research design-related fields.	English: 11.5, 11.8, 12.5, 12.8
40	Identify advanced drawing and design terminology.	English: 11.5, 12.5

41	Explain the engineering design process.	English: 11.5, 11.8, 12.5, 12.8
42	Analyze design solutions.	
43	Implement a design process needed to complete a design solution.	Mathematics: G.3, G.14
44	Prepare freehand preliminary sketches.	Mathematics: G.3, G.14
45	Develop skills related to using scale.	Mathematics: A.4, G.3, G.14
46	Develop measuring skills.	
47	Analyze a 3-D design model.	
48	Analyze multi-drawing sets.	
49	Present design ideas.	English: 11.1, 11.7, 12.1, 12.7
50	Reverse engineer products.	Mathematics: G.3, G.14
51	Construct physical models of designs.	
52	Develop blueprint reading skills.	
53	Generate multi-view orthographic projections from a 3-D design model.	
54	Generate specification schedules.	
55	Render presentation designs.	
56	Generate sectional views.	Mathematics: G.3, G.14
57	Create 3-D solid models using CAD.	Mathematics: G.14
58	Design parts and assembly drawings using coordinate systems.	Mathematics: G.3, G.10
59	Create working drawings and sheet sets.	
60	Dimension drawings, according to the standards of ANSI (American National Standards Institute), ISO (International Standards Organization), and NCS (National CAD Standards).	
61	Create layered multi-view, multi-scale drawings.	Mathematics: G.14
62	Demonstrate the use and manipulation of styles.	
63	Develop specification data.	
64	Use technical writing style in documentation.	English: 11.6, 11.7, 12.6, 12.7
65	Create a multimedia presentation of a finished design, incorporating animation files.	English: 11.2, 11.5, 12.2, 12.5
66	Investigate inventive methods of documentation.	English: 11.5, 11.8, 12.5, 12.8
67	Justify calculations and assumptions made during the design process.	Mathematics: A.4, G.1
68	Adhere to prescribed guidelines regarding equipment use, Internet use, personal conduct, and agency regulations.	English: 11.5, 12.5
69	Describe ethical issues in the design industry.	English: 11.5, 12.5 History and Social Science: GOVT.1

70	Identify the role of advanced drawing and design in manufacturing and construction industry processes.	English: 11.5, 12.5 History and Social Science: VUS.9, VUS.13, VUS.14
71	Characterize what collaboration is necessary between the design trades/fields.	
72	Present a complete work portfolio.	English: 11.2, 11.5, 11.6, 11.7, 12.2, 12.5, 12.6, 12.7

Entrepreneurship Infusion Units

Entrepreneurship Infusion Units may be used to help students achieve additional, focused competencies and enhance the validated tasks/competencies related to identifying and starting a new business venture. Because the unit is a complement to certain designated courses and is not mandatory, all tasks/competencies are marked "optional."

Appendix: Credentials, Course Sequences, and Career Cluster Information

Industry Credentials: Only apply to 36-week courses

- Architectural Apprentice Drafter Examination
- Architectural Certified Drafter Examination
- Architectural Drafting Assessment
- Architectural Drafting Examination
- Autodesk Certified Professional Examinations
- Autodesk Certified User Examinations
- Certified SOLIDWORKS Associate (CSWA) Examination
- College and Work Readiness Assessment (CWRA+)
- Mechanical Apprentice Drafter Examination
- Mechanical Certified Drafter Examination
- Mechanical Drafting and Design Assessment
- National Career Readiness Certificate Assessment
- Workplace Readiness Skills for the Commonwealth Examination

Concentration sequences: *A combination of this course and those below, equivalent to two 36-week courses, is a concentration sequence. Students wishing to complete a specialization may take additional courses based on their career pathways. A program completer is a student who has met the requirements for a CTE concentration sequence and all other requirements for high school graduation or an approved alternative education program.*

- Architectural Drawing and Design (8437/36 weeks)
- Architectural Drawing and Design (8492/18 weeks)
- Digital Visualization (8459/36 weeks)
- Engineering Drawing and Design (8436/36 weeks)
- Engineering Drawing and Design (8493/18 weeks)

Career Cluster: Arts, Audio/Video Technology and Communications	
Pathway	**Occupations**
Audio and Video Technology and Film	**Graphic Designer**
Performing Arts	**Costume Designer** **Lighting Designer**
Visual Arts	**Costume Designer** **Fashion Designer** **Graphic Designer** **Illustrator** **Interior Designer** **Textile Designer**

Career Cluster: Science, Technology, Engineering and Mathematics	
Pathway	**Occupations**
Engineering and Technology	**Aeronautical Drafter** **Architect** **Commercial and Industrial Designer** **Electrical Drafter** **Electronic Drafter** **Engineer** **Engineering Technician** **Landscape Architect** **Mechanical Drafter** **Pipeline Drafter**