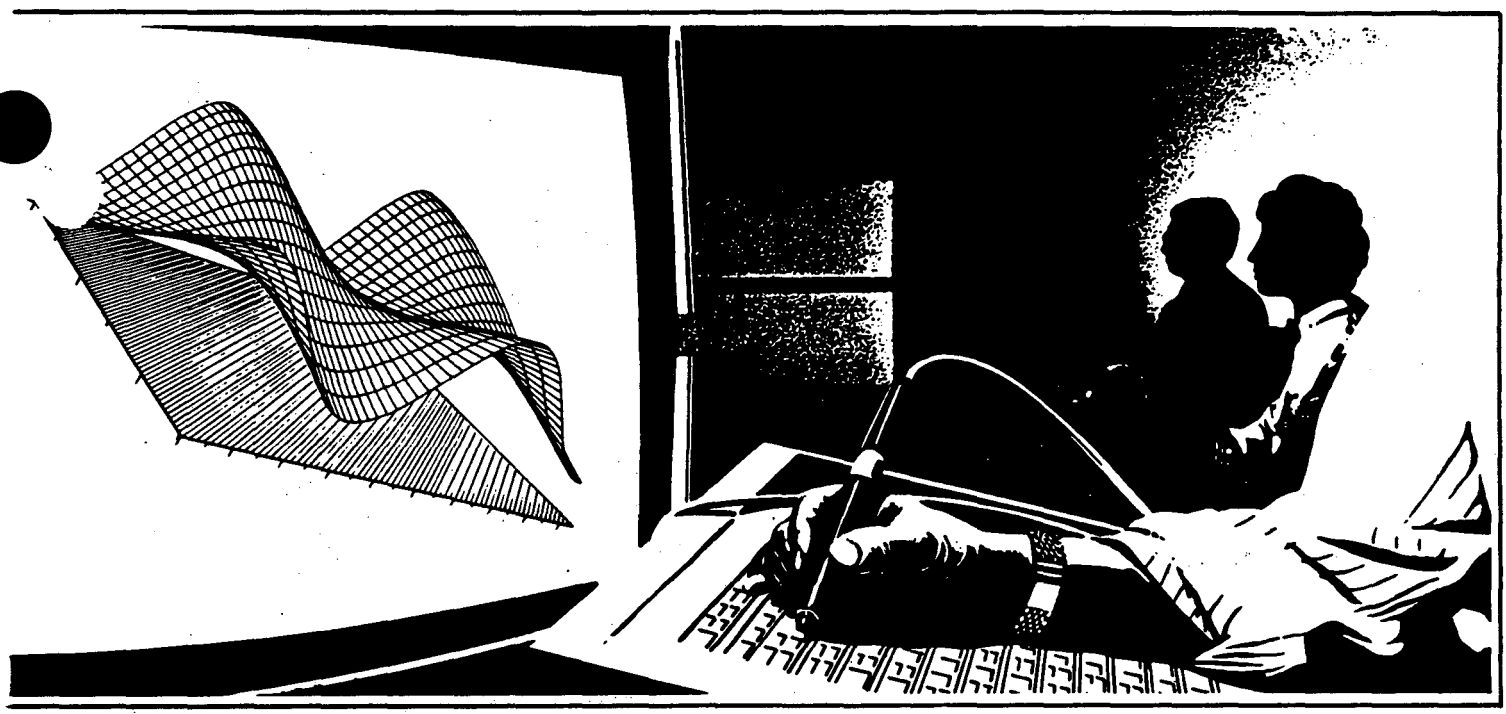
TECHNOLOGY EDUCATION
TECHNICAL DRAWING

GRADES 9-12
FOUNDATION BLOCK COURSE



The University of the State of New York
The State Education Department
Division of Occupational Programs
Albany, New York 12234

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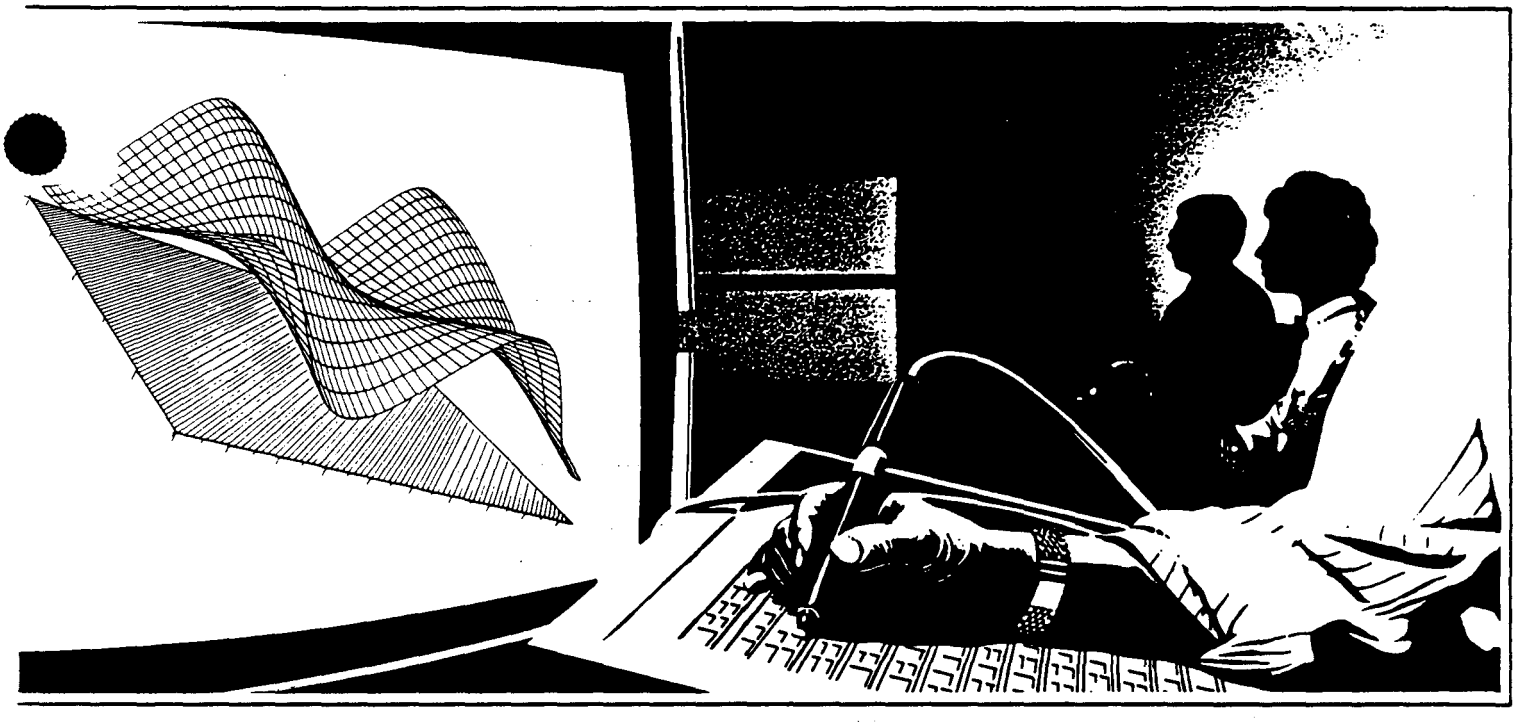

The University of the State of New York
The State Education Department
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Albany, New York 12234

June 1986

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TECHNOLOGY EDUCATION

COURSE: **TECHNICAL DRAWING**

MODULE: BASIC TECHNICAL DRAWING

TOPICS:
Introduction
Tools/Equipment and Materials
Lettering
Sketching
One- and Two-View Drawings
Dimensioning
Three-View Drawings
Career Exploration

MODULE: APPLICATIONS OF BASIC TECHNICAL DRAWING

TOPICS:
Geometric Construction
Sectioning
Isometric Views
Auxiliary Views
Developments
Drawing Reproduction

PREREQUISITES: None

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TOTAL TEACHING TIME: 18 weeks

June 1986

COURSE OVERVIEW

Course Description

This curriculum is designed to be used as a half-unit, 18-week course. Both 9-week modules contain topics which have given technical drawing its well deserved reference as a universal language. Technical drawing lends itself to be used as a foundation for enabling students to better relate to technology in general and systems theory in particular. The curriculum is also intended to promote an interest and understanding in the allied field of the visual arts.

The first module, "Basic Technical Drawing," provides a background and introduction to the world of technical drawing. The second module, "Applications of Basic Technical Drawing," uses the basic skills presented earlier in several applications of technical drawing. Both modules may be enhanced by employing computer assisted design (CAD) facilities. Instructors should also note that not all performance objectives are intended to be achieved solely by virtue of student drawings. Other approaches are encouraged, such as problem solving in groups or model building, as indicated in the accompanying instructional strategies. A list of recommended tools, equipment, and supplies and a list of resources are included at the end of the curriculum.

Instructional Methodology

A key feature of this course is flexibility. The material may be presented with the traditional large group approach, a small group approach, an individualized approach, or a combination incorporating the best aspects of all three. In addition, it is left to the teacher's discretion as to how many and which drawing assignments are required. Some topics may be covered by demonstrations, lectures, audiovisual lessons, and/or homework assignments. In almost every case, topics may be changed in sequence as circumstances dictate. Some instructors in the pilot study, for example, spread lettering and dimensioning through several of the other topics as opposed to keeping them as distinct learning units.

Because computers are used today in nearly every phase of engineering, science, business, and technology, it is strongly recommended that the material taught in this course be augmented with basic activities in computer aided design. The extent of involvement in this important area is dependent upon the instructor's knowledge and the amount and sophistication of equipment and software available.

In this course, the vast majority (75 percent or more) of a student's class time will be spent actively pursuing solutions to drafting problems, on paper or by using other media. Design, aesthetics, and model building may all be incorporated as supporting competencies to supplement actual drawing assignments. Technology Learning Activities (TLA's) are one way instructors are encouraged to present the information outlined in this course.

Instructional strategies preceded by * promote leadership skills in communication, decision-making/problem solving, human relations, management, and human motivation.

Course Credit

This course is part of the new State sequence in Technology Education. It is one of three half-unit courses which have been identified as foundation courses. They are Basic Electricity/Electronics, Energy, and Technical Drawing. Students completing a high school sequence in Technology Education must have successfully completed any two of these three foundation courses.

In addition to being taken to fulfill sequence requirements, this course may also be taken by any student as an elective. If the instructor uses this syllabus as a guide for instruction, students may be granted Regents credit for the course.

Special Populations Provision

Many students with handicapping conditions have, by definition, the intellectual capacity to master the curricular content requirements for a high school diploma. Such students must attain the same academic standards as their non-handicapped peers in order to meet these requirements. Students with handicapping conditions are provided instruction in a wide variety of settings from regular education classes to special education classes. Teachers of this course should become aware of the needs of those students with handicapping conditions who have been appropriately placed within their classes. Instructional techniques and materials must be modified as necessary so that the information can be attained by such students.

This course includes suggestions for modifying instructional strategies and materials to meet the needs of students with handicapping conditions. These suggestions are intended to provide teachers with a few examples and should be viewed as a base from which teachers in both regular and special education can develop additional strategies.

Youth Leadership Skills

Development of leadership skills is an integral part of occupational education in New York State. The New York State Education Department states that, "Each education agency should provide to every student the opportunity to participate in the education activities of the student organization(s) which most directly relate(s) to their chosen instructional program."

Leadership skills have been incorporated into the New York State occupational education curricula to assist students to become better citizens with positive qualities and attitudes. Every individual should develop skills in communication, decision making/problem solving, human relations, management, and motivational techniques.

Leadership skills may be incorporated into the curricula as competencies (Performance Objectives) to be developed by every student, or included within the Suggested Instructional Strategies. Teachers providing instruction through occupational education curricula should familiarize themselves with the competencies. Assistance may be requested from the State advisor of the occupational student organization related to the program area.

COURSE OVERVIEW, continued

Students who elect to become active members of one of the student leadership organizations charted by the New York State Education Department have the advantage of a practical forum to demonstrate leadership skills in an action oriented format and have the potential for recognition of their achievements at the local, state, and national levels.

COURSE: TECHNICAL DRAWING

CONTENT OUTLINE

MODULE: BASIC TECHNICAL DRAWING

I. Introduction

A. Historical Development
1. Cave drawings (traces)
2. Hieroglyphics (picture writing)
3. Oudea fortress (first-plan record)
4. Vitruvius (architect)
5. Alberti (architecture)
6. DaVinci (theory of perspective)
7. Gaspard Monge (descriptive geometry)
8. Claude Crozert (USA, descriptive geometry)
9. William Minifie (USA, technical drawing text)
10. Alteneder & Sons Co. (drawing instruments)
11. Blueprint process
12. Drafting machine
13. American National Standards Institute/American Society of Mechanical Engineers
14. Computer-aided drafting and design

B. Technical Drawing Terms
1. Descriptive geometry
2. Mechanical drawing
3. Engineering drawing and drafting
4. Technical drawing
5. Engineering graphics
6. Technical sketching
7. Blueprint reading

C. Branches of Technical Drawing
1. Architectural drawing
2. Structural drafting
3. Machine drawing
4. Sheet metal drawing
5. Electrical drafting
6. Aeronautical drawing
7. Civil drafting
8. Marine drawing

D. The Universal Language
1. Definition
2. Worldwide acceptance
3. Drawings vs. foreign language
4. Use in a technical world

E. Artistic vs. Technical Drawing
1. Definitions
2. Differences and similarities
3. Need for both

COURSE: TECHNICAL DRAWING

CONTENT OUTLINE, continued

MODULE: BASIC TECHNICAL DRAWING

F. Aims of Technical Drawing
   1. Technique
   2. Accuracy
   3. Neatness
   4. Speed

II. Tools/Equipment and Materials

A. The Meaning of Technical Drawing
   1. Definition
   2. Purpose
B. Drawing Equipment
   1. Used by draftspersons (T-square, triangle, lead pointer, etc.)
   2. Purpose of each item
   3. Use
C. Drawing Papers and Their Uses
   1. Drawing paper
   2. Tracing paper (vellum)
   3. Tracing cloth (linen)
D. Drawing Pencils
   1. Types
   2. Hardness/softness
   3. How to sharpen
E. Alphabet of Lines
   1. Definition
   2. Purpose of each line (border, object, section, etc.)
   3. Choosing the right pencil and constructing a line
F. Horizontal, Vertical, Inclined, Parallel, and Perpendicular Lines
   1. Use of T-square in line construction
   2. Use of triangle in line construction
   3. Use of T-square with triangles in line construction
G. Types of Scales and Their Uses
   1. How to read a scale
   2. Architect's scale
   3. Engineer's scale
   4. Mechanical draftsperson's scale
H. Construction of Circles and Irregular Curves
   1. The Giant Bow Set
   2. Compass
   3. French curve
   4. Circle templates
I. The Drafting Machine
   1. Parts/assembly and set-up
   2. Use

J. Tradespeople Using Technical Drawing
   1. Designers, fabricators, engineers, etc.
   2. Ways they use technical drawing
   3. Time-efficient items (automatic pencil, thin lead automatic pencil, Ames Lettering Guide, templates)
   4. Characteristics of their worlds of work

III. Lettering

A. Origin of Letters
   1. Definition of pictograph
   2. History of lettering (cavepeople to ANSI)
   3. The need for standardized lettering

B. Modern Letter Forms
   1. Roman
   2. Gothic
   3. Text

C. Uniformity in Lettering
   1. Line thickness
   2. Line slant (vertical/inclined)
   3. Uppercase and lowercase
   4. Numbers and fractions

D. Pencil Technique
   1. Choice of pencils
   2. Sharpening for lettering

E. Guidelines
   1. Purpose (horizontal, vertical)
   2. Spacing of guidelines
   3. Guideline devices (Braddock-Rowe Triangles, Ames Lettering Instrument)

F. Composing Letters, Numbers, Fractions, and Words
   1. Width to height comparisons of letters/numbers
   2. The stroke sequence

G. Lettering Devices
   1. Leroy Lettering Instrument
   2. Wrico Lettering Instrument
   3. Varigraph
   4. Tacro-Scriber
   5. Unitech Lettering Set

IV. Sketching

A. Purposes
   1. Communicate through pictures
   2. Formulate ideas
   3. Provide flexibility/design changes
   4. A graphic record

B. Sketching Equipment
   1. Pencils
   2. Paper
   3. Erasers
C. Techniques of Sketching
   1. Freehand lines
   2. Straight lines
   3. Arcs and circles
   4. Ellipses, squares, and cubes
D. Estimating Proportions
   1. Method of blocking horizontal and vertical lines
   2. Method of transferring distances
   3. Method of eyeballing objects
E. Levels of Sketching
   1. Temporary
   2. Permanent
   3. Presentation
F. Sketching an Object
   1. Pictorial/oblique, isometric
   2. By visualizing a single view from an object

V. One- and Two-View Drawings

A. Purpose of One- and Two-View Drawings
   1. Simplicity
   2. Elimination of duplication
B. Process of Visualization
   1. Center lines
   2. Hidden lines
   3. Contours
   4. Views that illustrate most detail
C. Process of Implementing One- and Two-View Drawings
   1. Drawing center lines
   2. Drawing hidden lines
   3. Drawing appropriate line weights

VI. Dimensioning

A. ANSI Standard Dimensioning Practices
   1. Dimension lines used
   2. Dimension line weights
   3. Dimension placement
   4. Arrowheads
   5. Inch marks
   6. Dimension figures
   7. Dimension notes

B. Size Dimensions Contrasted With Location Dimensions
   1. Size dimensions
   2. Location dimensions
   3. Tolerancing
C. Dimensioning Geometric Figures
   1. Prisms
   2. Cylinders
   3. Holes
   4. Cones
   5. Pyramids
D. Specialized Dimensions
   1. Angles
   2. Arcs
   3. Fillets and rounds
   4. Finish marks
   5. Continuous curves
   6. Mating parts
E. Notes on a Drawing
   1. General notes and their size
   2. Local notes
   3. Use of leaders

VII. Three-View Drawings

A. Purpose of Multi-View Drawings
   1. Exact method of communication
   2. Universal language
B. Process of Visualization and Implementation
   1. Ability to see an object abstractly ("the mind's eye")
   2. Drawing the visualized object
   3. "Glass box" method
C. Planes of Projection in Multi-View
   1. Top view and dimensions (width and depth)
   2. Front view and dimensions (width and height)
   3. Right side view and dimensions (height and depth)
   4. Elimination of bottom, left side, and rear views
D. Relationship of Views
   1. Proper placement
   2. Alignment
E. Types of Lines
   1. Hidden lines
      a. Purpose
      b. Method of constructing dashes and spaces
      c. Weight of line

COURSE: TECHNICAL DRAWING

CONTENT OUTLINE, continued

MODULE: BASIC TECHNICAL DRAWING

2. Center lines
   a. Purpose
   b. Method of constructing in views containing circles
   c. Weight of line
3. Visible/object lines
   a. Purpose
   b. Weight of line
4. Construction lines
   a. Purpose
   b. Weight of line

VIII. Career Exploration

A. Careers in Technical Drawing
B. Job Categories and Descriptions
C. Job Availability
D. Job Benefits/Environment
E. Opportunities for Advancement and Job Security
F. Education and Training Required for Job Entry

MODULE: APPLICATIONS OF BASIC TECHNICAL DRAWING

I. Geometric Construction

A. Importance of Geometry in Technical Drawing
   1. Identification and use of instruments
   2. Methods of solving geometric problems
   3. Accuracy in geometric constructions
B. Geometric Shapes in Technical Drawing
   1. Points
   2. Lines - straight, parallel, intersecting, perpendicular, skew, regular and irregular curved
   3. Angles - acute, right, obtuse, straight, reflex, complementary, and supplementary
   4. Circle and related parts - circumference, diameter, segment, tangent, chord, concentric, eccentric
   5. Triangles - right, equilateral, isosceles, scalene
   6. Quadrilaterals - parallelograms (square, rectangle, rhombus, and rhomboid), trapezoid, and trapezium
   7. Polygons - pentagon, hexagon, heptagon, octagon, nonagon, decagon, dodecagon

8. Regular solids - prisms, pyramids, cones, cylinders, and tetrahedrons
9. Spheres
10. Related terms - frustum, truncation, altitude, axis, vertex, base, element

C. Solving Geometric Problems - Definition of Terms, Applications, Procedures for:
1. Bisecting a line
2. Dividing a line into equal segments
3. Transferring angles and shapes
4. Bisecting angles
5. Drawing triangles to given specifications
6. Circumscribing and inscribing polygons
7. Drawing an arc through three given points
8. Transferring of an arc distance to a straight line
9. Drawing a circle tangent to a line
10. Drawing a line tangent to a point on a circle
11. Drawing an arc tangent to two straight lines
12. Drawing an arc tangent to a line and arc
13. Drawing an arc tangent to two other arcs
14. Drawing an ellipse (concentric circle and four center points method)

II. Sectioning

A. Purpose of Section Drawing
1. Preferred means of communicating an idea over a multi-view drawing
2. Process of visualizing sections

B. Understanding Special Terms
1. Cutting plane line
2. Direction of sight
3. Section lines
4. Break lines
5. Ribs/webs

C. Types of Sectional Views
1. Full section
2. Half section
3. Broken out section
4. Revolved section
5. Removed section (locating/labeling)
6. Rotated section
7. Ribs and spikes in section

D. Section Lines
1. Angle/direction
2. Weight of lines
3. Spacing

E. Section Line Symbols
1. General or cast iron
2. Specialized symbols

COURSE: TECHNICAL DRAWING

CONTENT OUTLINE, continued

MODULE: APPLICATIONS OF BASIC TECHNICAL DRAWING

F. Break Symbols
   1. Purpose
   2. Round objects
   3. Drawing "S" break with a template and/or compass
   4. "S" break freehand
   5. Metal or wood objects
   6. Long and short

G. Dimensioning
   1. General dimensions
   2. Over section lines

H. Selecting and Implementing Section Views

III. Isometric Views

A. Pictorial Drawing
   1. Definition
   2. Importance

B. Types of Pictorial Drawings
   1. Isometric/characteristics
   2. Oblique/characteristics
   3. Perspective/characteristics

C. Isometric Drawing Equipment
   1. Compass
   2. 30 degree triangle
   3. Dividers
   4. Cross-section paper
   5. Isometric ellipse template
   6. Other isometric templates

D. Sketching an Isometric
   1. Establishing a base line
   2. Establishing the 30 degree isometric axis
   3. Setting the height, width, and depth
   4. Ellipses, arcs, curves, and circles
   5. Angles and intersections

E. Mechanical Drawing of an Isometric
   1. Basic isometric block shapes
   2. Establishing basic axis lines (major and minor axis)
   3. Measuring of height, width, and depth
   4. Completing faces
   5. Angles in isometric/non isometric lines
   6. Compass ellipse construction
   7. Template ellipse construction
   8. Isometric sectioning
   9. Isometric dimensioning

COURSE: TECHNICAL DRAWING

CONTENT OUTLINE, continued

MODULE: APPLICATIONS OF BASIC TECHNICAL DRAWING

F. Methods of Shading
   1. Purpose
   2. Pencil
   3. Ink
G. Production Illustration
   1. Purpose
   2. Assembly (isometric)
   3. Sectional (isometric)

IV. Auxiliary Views

A. Inclined Surfaces
   1. Definition
   2. Distortion in regular views
B. The Auxiliary View
   1. Definition
   2. Purpose
C. Tradespeople Using Auxiliary Views
   1. Sheetmetal workers, product manufacturers, etc.
   2. Ways auxiliary views are used on the job
   3. Career categories
   4. Job descriptions, availability, benefits
   5. Opportunities for advancement and job security
   6. Education and training requirements for job entry
D. The Three Auxiliary Views
   1. Depth
   2. Height
   3. Width
E. Drawing Primary Auxiliary Views
   1. Establishing the line of sight
   2. Projection lines
   3. Establishing a reference plane
   4. Perpendicular projection lines from the plane
   5. Transferring points
   6. Completing the view

V. Developments

A. Developments (Patterns or Stretchouts)
   1. Definition
   2. Importance in today's technological world
   3. Terms
   4. Common uses (packaging, duct work, construction)

B. Geometric Solid Shapes
   1. Prisms
   2. Cylinders
   3. Cone
   4. Pyramid
   5. Truncations, inclination of solids

C. Types of Developments
   1. Parallel line
   2. Radial line
   3. Problem solving formulas and techniques
      a. True length of a line
      b. True size and shape of surfaces
      c. Triangulation
      d. R/S X 360 degrees = included angle of a cone

D. Transition Pieces
   1. Definition
   2. Methods of development
   3. Types of transitions

E. Steps in Analyzing Surface Developments
   1. Lay out stretchout line
   2. Set off segments of perimeter onto stretchout line
   3. Set off heights on fold lines
   4. Connect exterior points on development to complete pattern

VI. Drawing Reproduction

A. Identification of Drawing Surfaces
   1. Opaque
   2. Translucent tracing paper
   3. Cloth
   4. Film
   5. Fade-out grid and lined stock
   6. Illustration board

B. Reproduction Processes
   1. Blueprint
   2. Diazo (dry process, wet process)
   3. Electrostatic (xerography)
   4. Thermographic
   5. Photographic
   6. Microfilm
   7. Microfiche

C. Factors Considered in Reproduction
   1. Quality of copy reproduced
   2. Size
   3. Speed
   4. Color
   5. Cost

MODULE: BASIC TECHNICAL DRAWING

TOPICS:		Estimated Teaching Time
	Introduction	0.5 week
	Tools/Equipment and Materials	0.5 week
	Lettering	1.0 week
	Sketching	1.0 week
	One- and Two-View Drawings	2.0 weeks
	Dimensioning	1.0 week
	Three-View Drawings	2.0 weeks
	Career Exploration	1.0 week

PREREQUISITES: None

TOTAL TEACHING TIME: 9 weeks

MODULE: BASIC TECHNICAL DRAWING

OVERVIEW OF MODULE

Goal

This module provides the student with basic knowledge about technical drawing. The topics covered will enable the students to comprehend the need for technical drawing and its importance to today's technological world. Through hands-on learning activities, students will gain useful experience in freehand sketching, pictorial drawing, and mechanical drafting techniques.

Description

Basic Technical Drawing consists of topics designed to help students learn the basic drawing skills and knowledge involved in making engineering drawings. The instructor is advised to infuse in each topic its practical application to one or more of the systems of technology: Communication, Production (Manufacturing and Construction), and Transportation.

The following topics are covered in this module:

I. Introduction - Students should comprehend the need for technical drawing and its importance to today's technological world. This topic introduces this challenging, universal language. In addition, the topic addresses the importance of aesthetics and artistic design in the field of technology.

II. Tools/Equipment and Materials - Upon completion of this topic, students should have the knowledge, skills, and attitudes necessary to use drawing tools, equipment, and materials to complete object and line exercises.

III. Lettering - This topic addresses lettering practices used in the technical drawing field. Students will develop the ability to describe the importance of good lettering in technical drawing and to complete lettering assignments that are compatible with American National Standards Institute (ANSI) standards.

IV. Sketching - This topic introduces students to freehand sketching, giving them the knowledge necessary to formulate, express, and record ideas and objects in the form of sketches. Students will also be exposed to works of visual arts such as renderings and perspectives.

V. One- and Two-View Drawings - The material in this section describes the uses of one- and two-view drawings in the visualization of various objects and the procedures to execute such drawings.

VI. Dimensioning - Students are introduced to the use of standard dimensioning techniques as practiced in trade and industry.

VII. Three-View Drawings - This topic focuses on the skills necessary to visualize and develop a three-view drawing consistent with the standards of technical drawing.

VIII. Career Exploration - Students investigate the numerous careers involved with technical drawing and related fields.

MODULE: BASIC TECHNICAL DRAWING

OVERVIEW OF MODULE, continued

Skills, Knowledge, and Behaviors to be Developed

The ability to:

1. Trace the historical development of technical drawing
2. Explain the need for a technical means of communicating as contrasted with an artistic or written means of communicating
3. Use the principal items of drawing equipment available to draftspersons
4. Understand and use the different types of lettering styles appropriate to technical drawing
5. Produce quick, freehand, alphanumeric lettering that is neat and legible
6. Implement sketching procedures and develop aesthetic judgment
7. Generate one- and two-view drawings
8. Read and interpret standard dimensioning figures and correctly dimension a drawing
9. Describe the purpose of a three-view (multi-view) drawing
10. Develop a three-view drawing with dimensions
11. Relate current employment information to potential employment in the technical drawing field

MODULE: BASIC TECHNICAL DRAWING
TOPIC: Introduction

PERFORMANCE OBJECTIVES/SUPPORTING COMPETENCIES

1. Given a presentation of the historical development of technical drawing as related to the visual arts, the student will describe several aspects of this development, with a degree of understanding and completeness acceptable to the instructor.

   In order to do this, the student must be able to:

   a. Prepare a written and/or oral presentation tracing the historical development of technical drawing as it relates to the visual arts
   b. Explain why technical drawing is referred to as the universal language
   c. Contrast the need for artistic or written visual communication with the need for technical visual communication

2. After reviewing a glossary of technical drawing terms and the goals of technical drawing, the student will define five terms and state the aims of technical drawing, to the satisfaction of the instructor.

   In order to do this, the student must be able to:

   a. Write brief descriptions of technical drawing terms
   b. State all four aims that a drafting technician must achieve

3. Given a brief introduction to the diversity of the cultural heritages which have contributed to the visual arts, the student will report on one or more aspects of this relationship, with a degree of understanding acceptable to the instructor.

   In order to do this, the student must be able to:

   a. Select a specific country/culture and describe how the needs and wants of the population influenced the design of everyday items
   b. Prepare a written/oral presentation describing how the artistic products of a specific culture have influenced the culture
   c. Explain how painters, photographers, sculptors, architects, and other artists who design objects express ideas and feelings through the things they create

PERFORMANCE OBJECTIVES/SUPPORTING COMPETENCIES, continued

4. Given an appreciation of the aesthetic considerations concerning works of art, the student will demonstrate an understanding of these aesthetic judgments and apply them to works of art, to the satisfaction of the instructor.

   In order to do this, the student must be able to:

   a. Explain the most common details in specific works of art that are aesthetically pleasing
   b. Explain the aesthetic differences between any two items that serve the same purpose yet are produced by different sources
   c. View a sculpture or painting and answer the following questions:
      What is art?
      Why is this art?
      What do works of art offer that is different from that which other objects offer?
      What are some of the feeling that can result from looking at art?
   d. Critique/comment upon a work of art with respect to aesthetic considerations such as style, harmony, shape, appropriateness, impact, color scheme, technique, and uniqueness

SUGGESTED INSTRUCTIONAL STRATEGIES

*1. Bring in visual aids (slides, photos) of the people and objects related to the history of technical drawing.

2. Obtain and compare old drawing instruments/latest drawing equipment, old blueprints/new prints/computer prints, old drawing texts/new drawing texts.

3. Show plans as drawn by various branches of technical drawing.

*4. Have a student describe the shape of an object which is hidden from the class. Have students draw the object as it is being described.

5. Show a copy of drafting standards established by ASMK.

6. Procure and display/discuss drawings from foreign countries.

*7. Provide examples of well executed drawings that illustrate neatness, accuracy, and proper technique.

*8. Contrast artistic drawings and written descriptions with technical drawings.

9. Arrange a field trip to an industrial firm that employs individuals in various aspects of technical drawing.

MODULE: BASIC TECHNICAL DRAWING
TOPIC: Tools/Equipment and Materials

PERFORMANCE OBJECTIVES/SUPPORTING COMPETENCIES

1. Following reading and instruction on tools, equipment, and materials used in technical drawing, the student will name and describe tools, equipment, and materials used by a draftsperson, with a degree of accuracy and completeness acceptable to the instructor.

   In order to do this, the student must be able to:

   a. Name and describe selected items of drawing equipment
   b. List three types of technical drawing papers and their uses
   c. Identify the characteristics that differentiate the 12 lines that make up the Alphabet of Lines

2. Following instruction, the student will use the tools/equipment and materials of technical drawing to draw basic lines, with a degree of accuracy acceptable to the instructor.

   In order to do this, the student must be able to:

   a. Select pencils appropriate for the type of line being created
   b. Sharpen a drafting pencil to specifications provided by the instructor
   c. Use the T-square and triangles (or drafting machine) to construct an object that contains horizontal, vertical, inclined, parallel, and perpendicular lines
   d. Name and use the different types of scales
   e. Use drawing instruments to complete assigned drawing projects accurately and neatly

SUGGESTED INSTRUCTIONAL STRATEGIES

1. Show films/slides/video cassettes on mechanical drawing techniques, dimensioning, use of scales, and careers in technical drawing.

*2. Provide visual examples/displays of work done by professionals and former students, illustrating both good and bad technique.

3. Demonstrate and/or discuss how computer aided design (CAD) and drafting systems can be substituted for traditional manual drawing instruments.

4. Provide practice with applied mathematics, especially focusing on inches, fractions, and decimals.

*5. Conduct demonstrations on proper and safe use of equipment, including set-up and storage.

*6. Demonstrate proper line construction techniques.

SUGGESTED INSTRUCTIONAL STRATEGIES, continued

7. Assign problems requiring the use of a T-square, triangles, compasses, and other drawing instruments.

8. Assign a working drawing in another scale (size).

9. Assign a working drawing involving decimals.

10. Conduct a drawing performance test.

11. Use continuing evaluation procedures which reinforce students' technical drawing performance.

12. Invite guest speakers from engineering, drafting, or technical education fields.

13. Conduct a field trip to any of the following: civil engineering firms, light or heavy industry, architectural firms, electrical industries, or town planning boards.

MODULE: BASIC TECHNICAL DRAWING
TOPIC: Lettering

PERFORMANCE OBJECTIVES/SUPPORTING COMPETENCIES

1. Given a presentation of the history of lettering and the different types of lettering, the student will write a short review of this history and identify at least three different letter forms, including two unique characteristics of each, with a degree of accuracy and completeness acceptable to the instructor.

   In order to do this, the student must be able to:

   a. Trace and describe the history of lettering from prehistoric times to the techniques and styles used in technical drawing today
   b. Identify three different types of letter forms and point out unique characteristics of each form

2. Following a demonstration and presentation concerning lettering guidelines, procedures, and equipment, the student will produce lettering, to given specifications.

   In order to do this, the student must be able to:

   a. Explain the need for uniformity in lettering
   b. Choose a correct pencil for lettering and prepare it to specifications
   c. Read and use fractions to establish guidelines and scale compositions
   d. Create guidelines that are of correct weight and spacing, using conventional and guideline-device techniques
   e. Explain four characteristics of good lettering and types of lettering materials
   f. Demonstrate the proper sequence of strokes used to create any letter or number in the English alphabet
   g. Create letters and numerals that are properly spaced and proportioned

SUGGESTED INSTRUCTIONAL STRATEGIES

1. Have student find examples of different lettering forms shown in technical magazines.

2. Provide individual students with problems on letter forms, spacing, and composition within a given space.

3. Provide students with problems that require the use of the Braddock-Rowe Triangle, the Ames Lettering Instrument, the Wrico System, or CAD input.

4. Conduct a field trip to a local engineering firm.

5. Invite a draftsperson, typographer, or calligrapher to address the class on career opportunities and trends.

MODULE: BASIC TECHNICAL DRAWING
TOPIC: Sketching

PERFORMANCE OBJECTIVES/SUPPORTING COMPETENCIES

1. Given an overview on technical drawing plus a presentation and readings on sketching, the student will demonstrate knowledge of the value of sketches and sketching and discuss two or more types of sketches, with a degree of accuracy and completeness acceptable to the instructor.

   In order to do this, the student must be able to:

   a. Explain the importance of a sketch
   b. Describe why sketching is a valuable skill
   c. Identify and describe the various types of sketches and how they are used

2. Given instruction and sample problems, the student will implement sketching procedures and demonstrate the skills and techniques essential to creating art products such as rendering and perspective drawings, to the satisfaction of the instructor.

   In order to do this, the student must be able to:

   a. Identify the various sketching materials
   b. Draw line values which are appropriate for sample problems
   c. Sketch objects in relation to each other by estimating accurate proportions
   d. Develop a two- and/or three-dimensional model from a sketch drawn

3. Given a presentation and pictorial sketching, the student will demonstrate skill in using sketching solutions for problem assignments, with a degree of accuracy and completeness acceptable to the instructor.

   In order to do this, the student must be able to:

   a. Identify basic pictorial sketches
   b. Draw sketches in basic pictorial form
   c. Develop a basic multi-view drawing from a pictorial sketch
   d. Develop a two- and/or three-dimensional model from a drawn sketch

SUGGESTED INSTRUCTIONAL STRATEGIES

1. Conduct class discussions on verbal versus graphic language; the importance of sketching; organizing one's ideas through sketching.

2. Display and discuss examples of sketches (student and professional).

*3. Have students keep sketch ideas in a notebook.

4. Provide sketching problems which contain circles, squares, cones, cylinders, and cubes.

5. Have students complete two- and three-dimensional sketches (isometric, oblique, orthographic).

MODULE: BASIC TECHNICAL DRAWING
TOPIC: One- and Two-View Drawings

PERFORMANCE OBJECTIVES/SUPPORTING COMPETENCIES

1. Following presentations and assignments on sketching and technical drawing, the student will observe and identify the one or two views necessary to best depict an object, to the satisfaction of the instructor.

   In order to do this, the student must be able to:

   a. Prepare the process of visualization and implementation necessary to one- and two-view drawings
   b. Comprehend the purpose of one- and two-view drawings
   c. Understand the purpose for selection of proper views for one- and two-view drawings
   d. Identify when a one-view drawing should be implemented
   e. Identify when a two-view drawing should be implemented
   f. Understand the purpose of hidden and center lines in one- and two-view drawings
   g. Understand the various line weights found in one- and two-view drawings

2. Following presentations, demonstrations, assigned readings, and related assignments, the student will select and draw the one or two views necessary to adequately describe an object, to the satisfaction of the instructor.

   In order to do this, the student must be able to:

   a. Assimilate information provided to develop one- and two-view drawings
   b. Determine when the elimination of views is necessary in one- and two-view drawings
   c. Implement the use of hidden and center lines in one- and two-view drawings
   d. Implement the proper line weights in one- and two-view drawings

SUGGESTED INSTRUCTIONAL STRATEGIES

1. Discuss how one- and two-view drawings are used in industry.

2. Provide various shapes which can be visualized and implemented into one- and two-view drawings.

*3. Provide multimedia teaching aids which demonstrate one- and two-view drawings.

*4. Display/distribute previously drawn one- and two-view drawings for observation/review/discussion.

5. Develop tests requiring the implementation of one- and two-view drawings.

*6. Ask students to bring in one- and two-view drawings from books, magazines, or newspapers. Display the best, the most unusual, and any other category of interest.

SUGGESTED INSTRUCTIONAL STRATEGIES, continued

*7. Have students practice drawing the various line weights inherent in one- and two-view drawings and develop a chart.

MODULE: BASIC TECHNICAL DRAWING
TOPIC: Dimensioning

PERFORMANCE OBJECTIVE/SUPPORTING COMPETENCIES

1. Following instruction, the student will produce dimensioning arrows, lines, letters, and numerals, to the satisfaction of the instructor.

   In order to do this, the student must be able to:

   a. Use correct line weight/conventions and arrows
   b. Use common fractions and/or decimal dimensions
   c. Write letters and numerals in an accepted standard form
   d. Explain and properly use finish marks on given problems
   e. Interpret and use dimensioning notes, using guidelines and suitable size letters
   f. Apply standard dimensioning practices to assigned problems

SUGGESTED INSTRUCTIONAL STRATEGIES

*1. Provide visual examples/displays of work done by professionals and former students, illustrating both good and bad technique.

2. Show filmstrips/films/slides/video cassettes on dimensioning and careers in technical drawing.

3. Provide quizzes and tests on reading assignments and lecture/discussions.

4. Provide practice with applied mathematics, especially focusing on inches, fractions, and decimals.

5. Provide demonstrations on proper dimension line construction/spacing techniques.

6. Have students use Ames Lettering Guide for dimensioning.

7. Show how the plastic edge on many T-squares measures 3/8-inch, a preferable dimensioning space, and can be used to gauge horizontal dimensions.

8. Assign a working drawing involving decimals.

*9. Give students drawing problems for performance test on correct dimensioning.

10. Use continuing evaluation procedures which enhance student's dimensioning performance.

11. Arrange for a guest speaker whose work involves interpreting/applying drawing dimensions.

MODULE: BASIC TECHNICAL DRAWING
TOPIC: Three-View Drawings

PERFORMANCE OBJECTIVES/SUPPORTING COMPETENCIES

1. Following presentations and assignments on sketching and technical drawing, the student will describe, orally or in writing, the rationale for and implementation of three-view drawings, with a degree of accuracy and completeness acceptable to the instructor.

   In order to do this, the student must be able to:

   a. Define the process of visualization and implementation in multi-view drawing
   b. Describe the purpose of multi-view drawing
   c. List the basic views found in a multi-view drawing (front, top, and right side views)
   d. Identify the specific dimensions found in each view (height, width, depth)
   e. Describe the purpose of the basic views and their proper relationship to each other

2. Given a presentation on multi-view drawing and selected drawings, the student will identify, orally or in writing, which views are necessary and describe the use of and purpose for the various types of lines, with a degree of accuracy and completeness acceptable to the instructor.

   In order to do this, the student must be able to:

   a. Describe the purpose for the elimination of views
   b. Identify when a three-view drawing should be implemented
   c. Describe the typical line weights found in multi-view drawings

3. Following presentations, demonstrations, assigned readings, and related assignments, the student will construct a multi-view drawing, deciding which views to include as well as how to draw them, to the satisfaction of the instructor.

   In order to do this, the student must be able to:

   a. Visualize and implement information in order to develop a multi-view drawing
   b. Determine when the elimination of various views is necessary
   c. Implement the use of hidden lines when needed
   d. Implement the use of center lines when needed
   e. Implement the proper line weights in a three-view drawing

MODULE: BASIC TECHNICAL DRAWING
TOPIC: Three-View Drawings

SUGGESTED INSTRUCTIONAL STRATEGIES

1. Display multi-view drawings (student and professional).

2. Provide various basic and complex geometric shapes from which the students can develop multi-view drawings.

*3. Build and hinge a transparent plastic box to illustrate the method of third-angle projection and its principal planes.

*4. Develop matching views on acetate material which coincide with the geometric shapes which the students use. These acetate views can be taped onto the plastic box in order to match up with the shape of the principal planes of projection.

5. Provide handout sheets for students which contain samples of three-view drawings which have missing lines. Students should fill in the missing lines and check their work in comparison to a correct copy displayed on an overhead projector or an acetate copy of the handout with the missing lines filled in.

6. Have students draw a multi-view drawing and dimension it appropriately.

7. Discuss how multi-view drawings are used in industry.

MODULE: BASIC TECHNICAL DRAWING
TOPIC: Career Exploration

PERFORMANCE OBJECTIVES/SUPPORTING COMPETENCIES

1. Following a presentation(s) on job classifications within the field of technical drawing, the student will describe these broad job classifications, orally or in writing, and his/her expectation of holding such jobs, to the satisfaction of the instructor.

   In order to do this, the student must be able to:

   a. Identify major job classifications/categories associated with the field of technical drawing
   b. Demonstrate an understanding of the educational preparation and skills essential to the job categories

2. Following a presentation(s) concerning employment opportunities in occupations related to technical drawing, the student will describe the job market for persons skilled in technical drawing, to the satisfaction of the instructor.

   In order to do this, the student must be able to:

   a. Recognize the range of jobs that require technical drawing skills
   b. Demonstrate a knowledge of the current and projected market locally, in the state, or in the country for persons with the education and training essential to careers associated with technical drawing
   c. Demonstrate an understanding of the earning potential and career ladders open to persons with technical drawing skills

3. Given a presentation and overview of various occupations associated with technical drawing, the student will identify and expound upon five or more job titles, to the satisfaction of the instructor.

   In order to do this, the student must be able to:

   a. Identify at least five job titles in technical drawing and/or related fields
   b. Describe the career potential associated with each job title
   c. Identify essential education, skills, and training basic to each job title

SUGGESTED INSTRUCTIONAL STRATEGIES

1. Visit firms employing people involved with technical drawing or related field.

2. Invite guest speakers from any career involved with technical drawing.

*3. Have students undertake original research concerning careers related to technical drawing and report their findings to the group.

*4. Use appropriate reading assignments to stimulate technical drawing career interests.

*5. Assign (groups of) students to interview someone with a technical drawing background.

6. Display/examine drawings from various fields (blueprints, magazines, posters).

MODULE: APPLICATIONS OF BASIC TECHNICAL DRAWING

TOPICS:		Estimated Teaching Time
	Geometric Construction	1.0 week
	Sectioning	2.0 weeks
	Isometric Views	2.0 weeks
	Auxiliary Views	1.5 weeks
	Developments	2.0 weeks
	Drawing Reproduction	0.5 week

PREREQUISITES: Basic Technical Drawing

TOTAL TEACHING TIME: 9 weeks

MODULE: APPLICATIONS OF BASIC TECHNICAL DRAWING

OVERVIEW OF MODULE

Goal

This module is designed to build upon the concepts discussed in Basic Technical Drawing. Its purpose is to increase the student's proficiency in technical drawing by exposing him/her to more advanced industrial drawing techniques used to communicate graphically in today's technological world.

Description

This module introduces students to advanced drawing techniques and practices used in industry to communicate technical information. The module consists of topics designed to further develop a student's basic drawing skills, while also exposing the student to advanced drawing techniques required to communicate thoughts, ideas, and knowledge through engineering drawings. The instructor is advised to infuse in each topic its practical application to one or more of the systems of technology: Communication, Production (Manufacturing and Construction), and Transportation.

Applications of Basic Technical Drawing contains seven topics. The content of each topic is as follows:

I. Geometric Construction - Stresses the need to understand geometric construction and its importance to the field of technical drawing. Students will learn the language of geometric construction and use mechanical drawing instruments to solve a variety of geometric problems.

II. Sectioning - Familiarizes students with the purposes and the many different types of sections.

III. Isometric Views - Introduces students to three-dimensional or pictorial drawings. Specific skills and knowledge will be derived through the construction of isometric drawings.

IV. Auxiliary Views - Introduces the drawing techniques and skills used to depict inclined or curved surfaces.

V. Developments - Exposes students to the analytical drawing techniques required for surface layouts and geometric developments.

VI. Drawing Reproduction - Introduces students to drafting papers, cloth and films, copy reproduction techniques and equipment, and careers associated with reproduction of drawings. Emphasis will be placed on using the reproduction equipment found in the school laboratory to produce high quality reproductions.

MODULE: APPLICATIONS OF BASIC TECHNICAL DRAWING

Skills, Knowledge, and Behaviors to be Developed

The ability to:

1. Take a complex object and break it down into its simple geometric components (points, lines, planes)
2. Discuss how simple geometric shapes can be used to generate complex objects
3. Draw solutions to basic geometric construction problems using conventional drafting techniques
4. Determine when and what type of sectional view is appropriate
5. Identify and use drafting equipment to develop isometric drawings
6. Understand that isometric drawings can be derived from a three-view drawing drawn on some CAD systems
7. Draw a primary auxiliary view
8. Determine when and where an auxiliary view is necessary
9. Define the method of surface generation for geometric shapes
10. Analyze and describe the steps required for surface layouts
11. Reproduce a print using available laboratory equipment

MODULE: APPLICATIONS OF BASIC TECHNICAL DRAWING
TOPIC: Geometric Construction

PERFORMANCE OBJECTIVES/SUPPORTING COMPETENCIES

1. Given an overview and sample problem constructions, the student will draw selected geometric figures, to the satisfaction of the instructor.

   In order to do this, the student must be able to:

   a. Define and sketch all required geometric shapes
   b. Draw construction procedures accurately
   c. Understand instructor-established criteria for problem solutions

2. Given instruction in the utilitarian value of being versatile in the construction of geometric figures, the student will explain the significance of breaking down more complex shapes into their geometric parts, where applicable, to the satisfaction of the instructor.

   In order to do this, the student must be able to:

   a. Articulate the value of geometric construction in design
   b. Describe several common geometric shapes found in product design

SUGGESTED INSTRUCTIONAL STRATEGIES

*1. Have students identify objects in the home that represent the basic geometric components.

2. Unfold a variety of packages to show points, lines, and planes. Fold them back together again to show solids.

3. Make an audiovisual tape of the solution to geometric construction problems. Students can then review the solution as needed.

4. Make color pen solutions to each problem.

*5. Post correct student solutions to problems.

*6. Have advanced geometric problems to challenge talented students.

*7. Construct or purchase the various geometric shapes made out of wood, plastic, paper, metal.

8. Demonstrate the solution to geometric problems stressing the need for accuracy.

*9. Make large scale objects with simple breakdowns.

MODULE: APPLICATIONS OF BASIC TECHNICAL DRAWING
TOPIC: Sectioning

PERFORMANCE OBJECTIVES/SUPPORTING COMPETENCIES

1. Given a review on multi-view drawing, plus presentations, reading assignments, and discussion, the student will explain the rationale for using sectioning and the major elements in a section view, with a degree of accuracy and completeness acceptable to the instructor.

   In order to do this, the student must be able to:

   a. Define a multi-view drawing
   b. Describe how a section drawing is a preferred means of communicating an idea over a multi-view drawing
   c. Identify a section drawing
   d. Identify a cutting plane line
   e. Describe the purpose of a cutting plane line
   f. Define the process of visualization and implementation in section drawings

2. Given a presentation on sectional views, the student will demonstrate sectioning techniques and the various types of sections, to the satisfaction of the instructor.

   In order to do this, the student must be able to:

   a. Define the use of section lines (crosshatching)
   b. Describe how section lines are spaced and weighted in proportion to the view
   c. Describe the purposes for correct directionality in positioning section lines
   d. Identify a half section
   e. Describe why a half section is drawn
   f. Identify a broken section
   g. Describe why a broken section is drawn
   h. Identify revolved and removed sections
   i. Describe why a revolved and removed section is drawn
   j. Identify ribs and webs
   k. Describe the purpose of rotated features in a section
   l. Define the purpose of break symbols
   m. Describe the various break symbols for different materials
   n. Define the proper methods for dimensioning section views

3. Given presentations, demonstrations, assigned readings, and related assignments, the student will draw a section view, with a degree of accuracy acceptable to the instructor.

   In order to do this, the student must be able to:

   a. Visualize and implement information in order to develop a sectional drawing
   b. Implement the use of a cutting plane line
   c. State the proper implementation of spacing and weighting section lines in proportion to the view

PERFORMANCE OBJECTIVES/SUPPORTING COMPETENCIES, continued

d. Implement the correct directionality of section lines
e. Implement section line symbols for various materials
f. Implement the use of break symbols for various materials
g. Discriminate between and implement the use of half sections, broken sections, removed and revolved sections, rotated features in section
h. Implement the use of dimensioning section views

SUGGESTED INSTRUCTIONAL STRATEGIES

1. Provide various split wood block forms which have been predrilled, counter bored, and counter sunk. Illustrate the sectioned interior split apart versus a hidden line image which is drawn on the outside of the block.

2. Use the split wood block forms to illustrate a sectioned interior versus hidden line representation.

*3. Provide enough split forms for the entire class to draw.

*4. Have students display models of sectioned articles along with drawings. Use transparent colored plexiglas to illustrate the cutting plane line.

*5. Create a display illustrating materials and the sectioned symbols they represent.

*6. Provide parts of a small gas engine from which sections have been precut. Have students draw these parts as section drawings. (Be sure all parts are thoroughly cleaned.)

MODULE: APPLICATIONS OF BASIC TECHNICAL DRAWING
TOPIC: Isometric Views

PERFORMANCE OBJECTIVES/SUPPORTING COMPETENCIES

1. Given assigned readings and instruction, the student will describe the characteristics of pictorial drawings and the equipment used for isometric drawings, with a degree of accuracy and completeness acceptable to the instructor.

   In order to do this, the student must be able to:

   a. List two reasons why pictorial drawings are important
   b. Identify characteristics that differentiate the three types of pictorial drawings
   c. Identify the mechanical drawing equipment used in developing isometric drawings

2. Given instruction and sample problem solutions, the student will draw several basic isometric shapes and locate and draw isometric ellipses with a template and compass, to the satisfaction of the instructor.

   In order to do this, the student must be able to:

   a. Construct an isometric ellipse with a compass
   b. Sketch and mechanically draw an object in the isometric representation mode using appropriate equipment
   c. Locate and draw correctly with an isometric ellipse template (35 degrees, 16 minutes) an ellipse on each of the three standard isometric surfaces
   d. Draw an exploded assembly and incorporate the methods and techniques of shading to specifications

SUGGESTED INSTRUCTIONAL STRATEGIES

1. Show films on types of pictorials, techniques of drawing and centering isometric drawings, and careers that use pictorials.

*2. Conduct a lecture/discussion on what a pictorial drawing is, types of pictorials, and when to use isometric drawings. Explain concepts using overhead projector.

*3. Show examples of pictorial drawings and have students verbally label them.

*4. Have students do research to determine the frequency of pictorial use in textbooks, technical journals, and popular magazines.

*5. Have guest speakers (engineer, draftsperson) discuss the importance of pictorials and isometric drawings in their work.

6. Assign isometric drawings to students from text with a suitable progression in difficulty.

7. Have students compare and contrast views of objects with and without shading.

8. Plan a field trip to a local industry, architectural firm, or commercial art studio.

MODULE: APPLICATIONS OF BASIC TECHNICAL DRAWING
TOPIC: Auxiliary Views

PERFORMANCE OBJECTIVES/SUPPORTING COMPETENCIES

1. Given a presentation on the importance of auxiliary views, the student will explain the significant characteristics of auxiliary views, with a degree of accuracy and completeness acceptable to the instructor.

   In order to do this, the student must be able to:

   a. Describe the value of auxiliary views
   b. Identify the characteristics which differentiate the three categories of auxiliary views

2. Given a demonstration and sample problem solutions, the student will produce an auxiliary view, to specifications provided by the instructor.

   In order to do this, the student must be able to:

   a. Draw two views selected by the instructor
   b. Project lines off selected view
   c. Establish auxiliary plane
   d. Transfer distances appropriately from original view to auxiliary
   e. Draw an auxiliary view

SUGGESTED INSTRUCTIONAL STRATEGIES

1. Lecture on auxiliary views and the purposes for which they are used.

*2. Define inclined surfaces and have students find inclined surfaces in the objects around them.

*3. Provide visual examples of the three types of auxiliary views and have students label them while describing how they arrived at the decision.

*4. Provide students with a partially completed example of an auxiliary view and have them complete it.

*5. Provide students with a curve problem and have them generate an auxiliary curve to specifications.

6. Show a visual example of a partial auxiliary.

*7. Provide examples of tradespeople that use auxiliary views, and have students tell how they think tradespeople would use auxiliary views in their work.

8. Invite a tradesperson to be guest speaker.

9. Take a field trip to a drafting firm.

MODULE: APPLICATIONS OF BASIC TECHNICAL DRAWING
TOPIC: Developments

PERFORMANCE OBJECTIVES/SUPPORTING COMPETENCIES

1. Given an overview of the uses of developments, the student will relate their importance to various commercial users, such as sheet metal workers, with a degree of accuracy and completeness acceptable to the instructor.

   In order to do this, the student must be able to:

   a. Recall several uses for developments
   b. Relate these uses to practical applications
   c. Describe the importance of developments to commercial users

2. Given an introduction and sample problem solutions, the student will draw developments of assigned problems, to the satisfaction of the instructor.

   In order to do this, the student must be able to:

   a. Determine the appropriate method of development for various geometric solids
   b. Use the proper formulas and techniques when solving problems
   c. Draw neat and accurate layouts for each of the assigned problems
   d. Layout and assemble developments using paper/cardboard

SUGGESTED INSTRUCTIONAL STRATEGIES

1. Prepare/provide examples of products which must be designed through developments.

*2. Have students bring in and discuss packaging containers.

3. Arrange a tour of a sheet metal or package manufacturing plant.

4. Provide a guest speaker on the career opportunities using developments and intersections.

*5. Have students construct models of the layout problems.

*6. Have each student bring in a product and design packaging for the product. Students should also determine the size of a shipping package for a given number of that product.

7. Display students' intersection problem solutions.

*8. Have students build large models of transition pieces.

MODULE: APPLICATIONS OF BASIC TECHNICAL DRAWING
TOPIC: Drawing Reproduction

PERFORMANCE OBJECTIVES/SUPPORTING COMPETENCIES

1. Given a presentation and overview of the different types of drafting papers, cloths, and films and of the various copy reproduction processes, the student will identify at least three types of media and their uses in copy reproduction, with a degree of accuracy and completeness acceptable to the instructor.

   In order to do this, the student must be able to:

   a. Name three or more types of paper, cloth, or film
   b. Differentiate between the reproduction qualities of papers, cloth, and films
   c. Identify the various reproduction techniques and purposes for which they are used

2. Given a demonstration on the correct usage of reproduction equipment, the student will use this equipment to make copies, to the satisfaction of the instructor.

   In order to do this, the student must be able to:

   a. Select appropriate device
   b. Operate the device selected
   c. Use information provided with respect to print quality, sizes of copy possible, speed, color, and cost
   d. Make one or more copies successfully

SUGGESTED INSTRUCTIONAL STRATEGIES

1. Use a slide series to show the equipment which is used in the reproduction of technical drawings.

2. Show examples of finished technical drawings which have been reproduced by the various processes. Have students contrast advantages and disadvantages of each process, orally or in writing.

3. Have students reproduce a print on existing laboratory equipment.

*4. Arrange a field trip to a firm that uses modern reproduction equipment.

SUGGESTIONS FOR STUDENTS WITH SPECIAL NEEDS

Special education students who are appropriately mainstreamed should be able to master the competencies contained in this module. The strategies below are provided as a resource for the occupational instructor to meet individual student needs.

1. Provide brief, sequential written and oral directions for students.

   - Have students develop a checklist where instructional activities include several steps. As each step is completed, the student can check it off.

2. Allow students to make oral presentations in addition to submitting written work, where appropriate. Students might be permitted to submit audio tapes along with written material.

3. For math related activities, allow the use of a calculator where students can benefit from this assistance.

4. Provide students with vocabulary lists and definitions of key terms to study at home or in their special education program. These lists might also be provided to the student's special education teacher.

5. Allow handicapped students to work with a peer during class demonstrations and group problems/exercises.

6. Encourage handicapped students to maintain a notebook containing information presented during class, field trips, etc. Periodically, inspect the notebook for organization and sequencing of key points covered during the course.

7. For some students, worksheets and other written material may need to be simplified and organized so as to present concepts in a more gradual manner.

8. Written directions and instruction for class work may be helpful for some students in addition to those provided verbally.

9. Explain practices thoroughly. Provide practical illustrations. Simplify vocabulary by assocation with familiar words.

10. Instruct the student to practice a task beyond initial mastery. Improvement in learning, retention, and transfer will be facilitated by overlearning.

11. Remember, the special needs student may require additional review and reinforement of learned material. In order to facilitate the process, enlist the help of the student's special education teacher or building resource person to assist in providing supplemental instruction. Share manuals, textbooks, vocabulary lists, and lesson outlines with this person.

COURSE: TECHNICAL DRAWING

RECOMMENDED TOOLS, EQUIPMENT AND SUPPLIES FOR THE TECHNICAL DRAWING CURRICULUM

French Curve
Brush
Scale, Architects
Dividers
Pencils: HB, H, 2H, 4H
Eraser
T-square
Drawing Board
Parallel Rule
Drafting Machine
Textbooks, Workbooks
Technical Inking Pens
Chalkboard Instruments
Copy Machine
Modeling Clay
Lead Pointer
Adjustable Triangle
Protractor
Erasing Shield
Compass, Bow and Beam
30-60 deg. Triangle
45 deg. Triangle
Circle Template
Ellipse Template
Lettering Template
Ames Lettering Guide
CAD Station
Colored Pencils and Markers
Paper - Blank, Graph, Tracing
Model Making Tools and Materials
Drafting Tape
Pencil Sharpener
Sanding Pad

COURSE: TECHNICAL DRAWING

RESOURCES

American Institute for Design and Drafting, 3119 Price Road, Bartlesville, OK 74003.

American National Standards Institute (ANSI), 1430 Broadway, New York, NY

Benson, H. and A.G. Carey. The Elements of Lettering. New York: Gregg/McGraw-Hill Book Co.

Betterley, M.L. Sheet Metal Drafting. New York: Gregg/McGraw-Hill Book Co.

Earle, J.H. Design Drafting. USA: Addison-Wesley Publishing Co., 1972.

Feirer, J.L. and J.R. Lindbeck. Basic Drafting. New York: Chas. A. Bennett, 1978.

French, T.E., C.L. Svensen, J.D. Helsel, and B. Urbanick. Mechanical Drawing, 9th ed. New York: Gregg/McGraw-Hill Book Co., 1980.

Giachino, J.W. and H.J. Beukema. Engineering Technical Drawing, 4th ed. New York: American Technical Society, 1978.

Helsel, J. and S. Coover. Reading Engineering Drawings Through Conceptual Sketching. New York: Gregg/McGraw-Hill Book Co.

Horton, Rotmans, and Good. Basic Drafting Technology, Albany, NY: Delmar Publishers, 1980.

Pare, E.G., R.O. Loving, and I.L. Hill. Descriptive Geometry, 5th ed. New York: Macmillan Publishing Co, 1978.

Pare, E.G., R.O. Loving, and I.L. Hill. Descriptive Geometry Worksheets, 7th ed. New York: Macmillan Publishing Co., Inc. Series A, B, and C.

Sinewitz, J. Technical Graphics. USA: Addison-Wesley Publishing Co., Inc. 1973.

Spence, William P. Drafting Technology and Practice, revised edition. New York: Chas. A. Bennett, 1980.

Spencer, H.C. and I.L. Hill. Technical Drawing Problems, Series 3, 3rd ed. New York: Macmillan Publishing Co., 1980.

Spencer, H.C. and J.T. Dygdon. Basic Technical Drawing, 2nd ed. New York: Macmillan Publishing Co., 1980.

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Stiss, F.A. Systems Drafting: Reprographics for Architects and Engineers. New York: Gregg/McGraw-Hill Book Co, 1981.

Thomas, T.A. Technical Illustration. New York: Gregg/McGraw-Hill Book Co., 1980.

Walker, J.R., Exploring Drawing. Bloomington, IL: Goodheart-Willcox, 1982.

Wallach, Paul, Drafting. Glencoe Publishing, California, 1981.

Yankee, H.W. Machine Drafting and Related Technology. New York: Gregg/McGraw-Hill Book Co, 1981.

TECHNOLOGY LEARNING ACTIVITIES (TLAs)

One of the more unique aspects of the Technology Education Program has been the creation of Technology Learning Activities, or TLAs. TLAs will provide teachers with laboratory activities which can be used to enable students to meet the performance objectives and to communicate the major concepts identified in each of the curriculum modules. In addition to being used by teachers as actual laboratory activities, TLAs will serve as models for Technology teachers who are encouraged to develop their own.

This Technology Learning Activity has been prepared as a model for teachers to follow in developing additional laboratory activities.

Major concepts and performance objectives identified within the syllabus are accomplished through activity outlined on the page entitled "Procedure for this Activity."

Key elements of the Technology Learning Activities are the problem-solving approach incorporated within the activity, and the link between Technology and other disciplines established by the ten identified constants.

TECHNICAL DRAWING
H.S. TECHNOLOGY LEARNING ACTIVITY

TLA TITLE: DESIGN AND SKETCH A PORTABLE DRAFTING TABLE OR A WALL-MOUNTED,FOLD-UP TABLE

MODULE: BASIC TECHNICAL DRAWING **TIME IN DAYS:** 5 Days

TOPIC: INTRODUCTION,SKETCHING, THREE-VIEW DRAWING, AND CAREER EXPLORATION

SKILLS, KNOWLEDGE AND BEHAVIORS

1. Rapid placement of ideas on paper to communicate ideas.
2. Review of the methods and materials required for constructing a particular object.
3. Application of the concepts of form and function towards useful design.
4. Development of proportion and line values towards the composition of a refined sketch.
5. Sketch an object pictorially and/or orthographically.

OVERVIEW OF TLA

In this TLA the students will be asked to design a portable drafting table that can be quickly and easily assembled and disassembled or a wall-mounted, fold-up drafting table that can easily be folded flat against the wall for convenient storage.

Each student will be given an outline that states the problem, limitations, and criteria for evaluation.

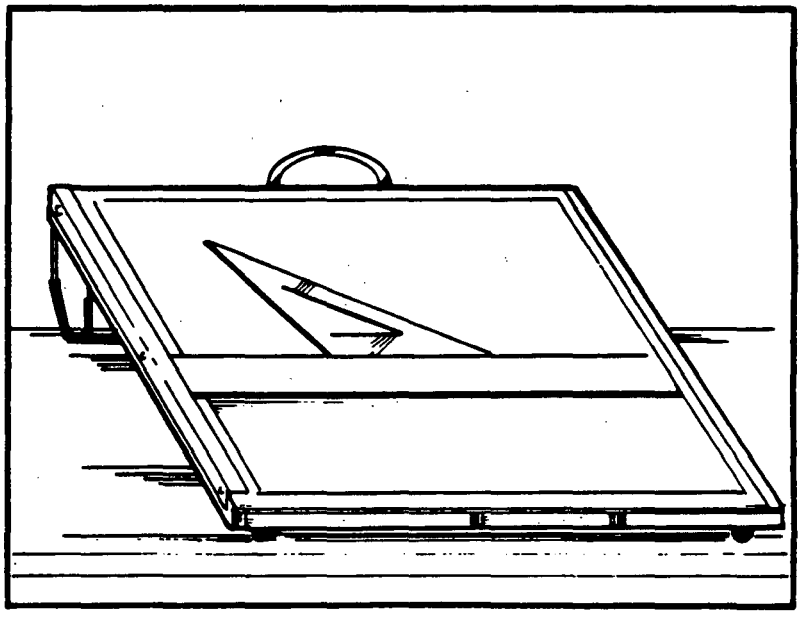
Students will be given lessons on design and sketching as well as basic construction and fastening techniques. The students will be evaluated on their originality of design and their pictorial and orthographic sketches.

EQUIPMENT AND SUPPLIES

Examples of various types of fastening devices and wood-working joints.

Equipment made available:

Drawing board, T-square, triangles, pencils, architects scale, graph paper, tracing paper, cardboard, tape, drafting machine, perspective board, etc.



See Basic Technical Drawing for Performance Objectives related to the following topics:

Topic	Abbreviation
Introduction	IN
Sketching	SK
Three-View Drawing	TV
Career Exploration	CE

PROCEDURE FOR THIS ACTIVITY

Time Days	POs	Teacher Activity	POs	Student Activity
1	SK1	Explain and demonstrate estimating sketching and drawing and their importance to each of us. Discuss three levels of sketching: 1. Temporary - Rough and Dirty 2. Permanent - Neat and Washed 3. Presentation - Clean and Beautiful	SK1	Listen to presentation. Ask questions. Sketch with ordinary paper and pencils.
	IN1 SK3	Define Communication Show how sketching fits in and is of value to entrepreneurs, architects, engineers, doctors, laborers, students. Show samples of famous sketches via slides and books.	IN1 SK3	Take notes. Try hand at sketching on graph paper, lined sketching paper, plain paper, and colored paper. Distinguish from given sketches which type is being presented.
	SK 2&3	Sketch by use of oblique, isometric- as false perspective- and true perspectives as of one and two point	SK 2&3	Sketch an object in oblique, isometric, one- and two-point perspective.
	IN1 SK1	Discuss and review value of the skill of sketching and its relation to communication.		
	SK2	Homework Assignment: To sketch a rough and dirty view of the street from own front door. To sketch an object from the kitchen at home. To sketch and keep secret an object to be used in communication without words.	IN1 SK1, 2,3	Sketch two-point perspective of his/her street, an object from the kitchen, a secret object for communication presentation without words. Discuss own sketches from a technical point of view
1		Quiz See Evaluation of Performance Objectives		Students take quiz Demonstrate knowledge of oblique, isometric, 1 and 2 point perspective ar are able to discuss value of sketching in related fields of possible endeavor.
	SK 2,3	Demonstrates skillful sketching on a variety of materials. Show sketches by famous people through slides from references and books.	SK 2,3 IN4	Students watch, observe, and ask questions about techniques and material to make choices for their attempts at using these techniques.

Total Days

PROCEDURE FOR THIS ACTIVITY

Time Days	POs	Teacher Activity	POs	Student Activity
	SK2	Call attention to line values in own work, work of others. Point out the accuracy of proportions. Conduct a mini lecture on the golden rectangle. Show proportion in famous works of art and sketches of products that the students have seen.	SK2	Sketch objects using appropriate pencils for line width and density. Practice proportion with eyes closed. Sketch sample lines with eyes closed. Look at and sketch from slides and objects in the room. Estimate accurate proportions. Sketch objects with different kinds of holes, squares, rectangles, triangles, circles, etc.
	SK3	Displays objects brought in for sketching.	SK3	Sketch objects which teacher displays.
		Assign the sketch problem of a portable or a fold-up drafting table. These problems require essentially the same skills but fit different needs.		Discuss possible solutions, sketch ideas to solve problems. Keep logs of ideas, sketching ideas capturing sketches in quick and dirty manner (Capture ideas). Practice estimation and proportion.
	SK3	Assignment includes the development of a dimensional model out of cardboard, paper, rivets and foam core of the object they design for the solution to the problem.	SK3	Begin designing and sketching a portable drafting table or a fold-up drafting table that attaches to a wall or track.
	CE 1,2 3	Invite guests to come in and display commercial samples of sketches and explain their use in communication--be it in architecture, engineering, automotive manufacturing, medical engineering.	CE 1, 2,3	Listen to guest speaker, ask questions about the technical aspect of what being presented.
1	SK3	Review pictorial sketches and one- and two-point perspective sketches.		Sketch pictorials of their ideas for the drafting table project.
	TV1 2,3	Lecture briefly on three-view drafting.	TV1 2,3	Sketch three-view drafting of their ideas for solving the problem.
		Review three-dimensional model of project. Use student project to show progress.		Work on three-dimensional model of solution to the problem.
1		Call on students for project updates, comment on the new skills being shown. Asks questions about how the students feel about new skills. Call for comments on other students work--sketches.		Take turns briefly discussing own sketches. Show first and last sketches to date. Display improved skills. Discuss and critique the work completed.
---	CE3	Homework: Gather job titles from DOT and other references showing sketching requirements.	CE3	Students check DOT and various other references to find job titles that use sketching as a skill requirement.
Total Days				

PROCEDURE FOR THIS ACTIVITY

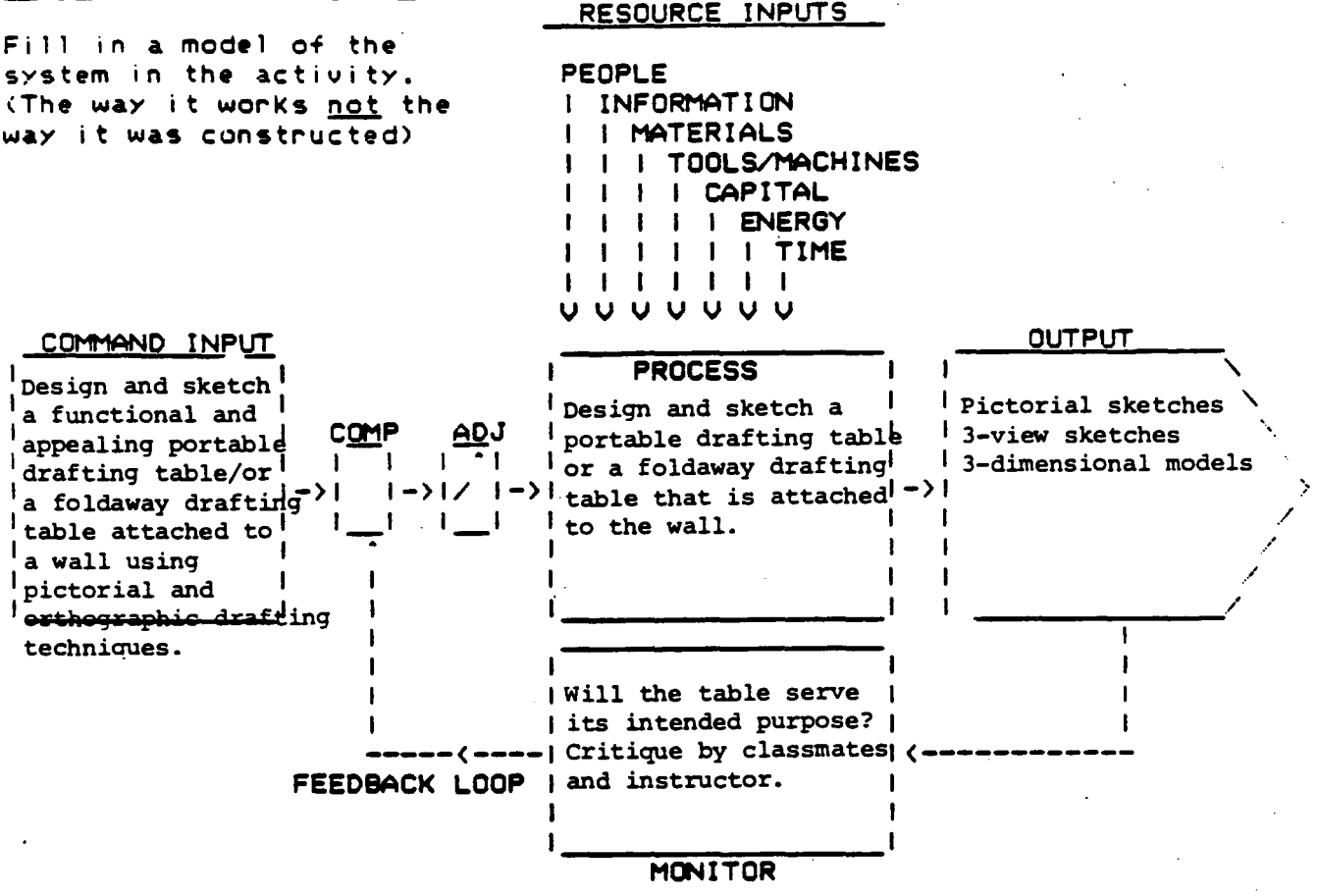
Time Days	POs	Teacher Activity	POs	Student Activity
	CE1 2,3	Discuss jobs advertised in newspapers, commenting on salary, and career potential. Read want ads from old and recent newspapers describing job requirements.	CE1 2,3	Comment on ads and career potential and interests. Students read their ads and discuss 5 job titles they found.
	SK1	Critique student work and communication skills. Operate stop clock so that the reports are kept on schedule.	SK1	Report on projects. Comment on progress made, improvements in basic sketching skills. Keep report short. Tell why they think they have the potential to qualify for a position because of basic skills they developed.

Total Days				

CONSTANTS FOR INFUSION INTO THE TLA

1) SYSTEM OF TECHNOLOGY

Fill in a model of the system in the activity. (The way it works not the way it was constructed)



IDENTIFY THE ROLE OF THE FOLLOWING RESOURCES IN THE SYSTEM ABOVE:
PEOPLE, INFORMATION, MATERIALS, TOOLS & MACHINES, CAPITAL, ENERGY, TIME.

CONSTANTS FOR INFUSION INTO THE TLA

2) MATH Measuring, proportion, and ratios will be discussed. Calculations of weight, cost of individual production, multiple production, and mass production.

3) SCIENCE Discussion of ergonomics, stress on parts, strain, mass, friction, strength of materials.

4) HUMAN & SOCIAL IMPACTS Designing furniture that is comfortable, appealing, and functional. Discussion of the human problems that are associated with poorly designed products of all kinds--not just furniture. These ideas may transfer and apply to many other situations.

5) COMMUNICATION SKILLS - Each student will compile a set of sketches. These sketches will eventually be presented by the student to the class. Presentations of certain students may be before an assembly of the entire student body.

6) SAFETY AND HEALTH - Discussion of sturdy and comfortable design in dozens of products including airplanes and amusement park rides, etc.

7) PSYCHOMOTOR SKILLS - Development of hand-eye coordination and mind stimulation for communication skills.

8) CAREER RELATED - Students are exposed to the fields of industrial design, engineering and modelmaking, communications, production planning, ergonomics, science, mathematics, and other related fields.

9) CREATIVE PROBLEM SOLVING -Opportunities for creative problem solving will be provided by this TLA including: identification and definition of a problem, goal and criteria setting, generation of alternative solutions and recognition of limitations, optimization, testing, and evaluation. Students will face many problems out of the school context. These problems may be approached in a similar manner and students should be encouraged to use the process in solving problems.

10) TRANSFER OF LEARNING - Apply the problem solving approach to purchasing furniture, cars, clothing, bedding, houses-in fact the idea is to use concepts of design in everything that one buys or makes in the future. The use of problem solving as a method of teaching invites the use of transfer to new situations beyond the classroom. Getting students to use problem solving in future unknown situations is as important as the lessons of the original situations for they are revisited and applied.

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French, T.E., C.L. Svensen, J.D. Helsel, and B. Urganick. Mechanical Drawing, 10th ed. New York: Gregg/McGraw-Hill, 1985.

Giesecke, Frederick E., et al. Technical Drawing, 6th ed. New York: Macmillan Publishing Co., 1974.

Ramsey, Charles G. and Harold R. Sleeper. Architectural Graphic Standards, 6th ed. New York: John Wiley and Sons, 1970.

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Stephenson, George E. Drawing for Product Planning. Peoria, IL: Charles Bennet Co. 1970.

EVALUATION

The teacher should develop a two component evaluation system to determine if the student understands: (1) performance objectives and (2) skills, attitudes, knowledge & safety related to the specific lab activity.

(1) EVALUATION OF PERFORMANCE OBJECTIVES (Examples)

1. Distinguish between isometric and oblique sketches.
2. Distinguish between one- and two-point perspective drafting.
3. Explain why everyone should sketch and show some skill in presentation sketches.
4. Describe the use of various pencils in sketching.
5. List the different types of erasers.
6. Describe some aspects of papers used for sketching.
7. Choose from the supplied paper the one that best fits the criteria for sketching this three-dimensional model and do it with appropriate pencils and skills.
8. Given a situation (teacher should manufacture one that might take place 10 years down the road), list the methods to use to alleviate the situation. (The concept needed is to have the student apply what she/he has learned in class to the new situation many years down the road.)

(2) EVALUATION OF SKILLS, ATTITUDES, KNOWLEDGE & SAFETY (Examples)

1. Does the sketch transmit the details so that the item could be manufactured?
2. Is the object functional? Utilitarian?
3. Would the manufactured product be esthetic?
4. Are the sketches/drawings technically correct?

APPENDIX:

1) IDENTIFY THE ROLE OF THE FOLLOWING RESOURCES IN THE SYSTEM: PEOPLE, INFORMATION, MATERIALS, TOOLS AND MACHINES, CAPITAL, ENERGY, TIME.

PEOPLE: Motivated student designers

INFORMATION: Average physical size of people for whom the project is being designed - ergonomics

MATERIALS: Many suitable papers - graph, lines, plain, sketching

TOOLS AND MACHINES: Standard drafting equipment

CAPITAL: School budget allocation (minimum investment required); budget for proposed project

ENERGY: Energy used for producing proposed portable board - energy to create design, energy for parts, redesign

TIME: 5 hours - Design, Production/Manufacture, Distribution

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