Blueprint Reading

Unit: Core Applied Skills

Problem Area: Project Design and Management Tasks

Lesson: Blueprint Reading

Student Learning Objectives.

Instruction in this lesson should result in students achieving the following objectives:

1. **Review blueprint tool specifications.**
2. **Interpret blueprint symbols, notes, and abbreviations.**
3. **Create built models.**

Resources.

The following resources may be useful in teaching this lesson:

E-unit(s) corresponding to this lesson plan. CAERT, Inc. http://www.mycaert.com.

Brown, C. Walter, and Daniel P. Dorfmueller. *Print Reading for Construction: Residential and Commercial*, 6th ed. Goodheart-Willcox, 2012.

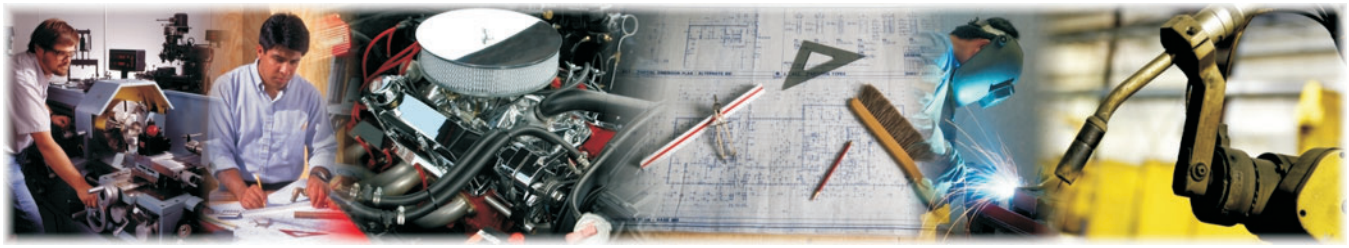
"Construction & Building," *ASME*. Accessed Nov. 2, 2013. https://www.asme.org/engineering-topics/construction-building?cm_re=Home-_-Hot%20Topics-_-Construction-Building.

"How to Read Blueprints," *England Design Company*. Accessed Nov. 2, 2013. http://www.englandhouseplans.com/Howtoreadblueprints.htm.

Madsen, David A. *Print Reading for Engineering and Manufacturing Technology*, 3rd ed. Cengage, 2012.

Madsen, David A. *Engineering Drawing and Design,* 5th ed. Cengage, 2012.

"Renewable Energy Sources," *ASME*. Accessed Nov. 2, 2013. https://www.asme.org/engineering-topics/renewable-energy?cm_re=Home-_-Hot%20Topics-_-Renewable-Energy.



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Equipment, Tools, Supplies, and Facilities

- ✓ Overhead or PowerPoint projector
- ✓ Visual(s) from accompanying master(s)
- ✓ Copies of sample test, lab sheet(s), and/or other items designed for duplication
- ✓ Materials listed on duplicated items
- ✓ Computers with printers and Internet access
- ✓ Classroom resource and reference materials

Key Terms.

The following terms are presented in this lesson (shown in bold italics):

- blueprints
- blueprint reading
- compass
- drafting boards
- drawing scale
- lead pointer
- protractor
- scale ruler
- symbol
- T-square

Interest Approach.

Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

> *Introduce the blueprint reading lesson by engaging the students directly with objects and spaces they know. For example, have students create technical drawings of some of their belongings—cellphone, ear buds, watch, or the classroom. Then have the students build models from these drawings. This helps create a direct relationship with the students and gets them excited about drawing and building. You could have the students build a model using another's drawings. Using another person's drawing helps reinforce how important it is to create an accurate drawing. Blueprints are accurate representations of objects and spaces.*

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CONTENT SUMMARY AND TEACHING STRATEGIES

Objective 1: Review blueprint tool specifications.

Anticipated Problem: Which tools are used to create technical drawings?

I. Blueprint tool specifications

A. ***Blueprints*** are reproductions of technical drawings that use a contact print process on light-sensitive material. The print process creates white lines on blue paper. Large black-and-white plotters have largely replaced this process. The lines are now black on white paper. However, the term "blueprint" is still used to describe copies of technical drawings. ***Blueprint reading*** is the interpretation of the language—symbols, notes, and abbreviations—found on construction, schematics, and wiring diagrams. For example, blueprints contain the following information via symbols, notes, and abbreviations:

1. Scale of the drawing
2. Height, width, and length dimensions
3. Symbols and notations
4. Multiview detailed sketches of objects

B. Material and tool specifications

1. ***Drafting boards*** are smooth, hard rectangular surfaces on which paper or canvas is placed for drawing. The most common medium for technical drawings is vellum or bond paper. The paper is fixed to the board with drafting tape. Mylar—the trade name for a thin, strong polyester film—is a semi-transparent drafting medium that works well with the contact print process (the blueprint-making process).
2. A ***T-square*** is a tool that consists of a head and a blade (or straightedge) used to draw straight lines. It is used to create straight horizontal lines or in conjunction with triangles to create vertical and diagonal lines.
3. The two standard triangles used for drafting tasks are the 30-60-degree and the 45-degree. They are used alone to create 30-, 60-, and 45-degree diagonal lines or in combination to create additional angles. Additionally, adjustable triangles create a full range of angles.
4. A ***compass*** is a tool used to draw circles and arcs on architectural or engineering plans. It has two adjustable legs. One leg has a metal point (needle) at the end, and the other leg has a holder for a pencil or lead. The two legs are adjustable in order to create various sizes of circles and arcs.
5. A ***lead pointer*** (pencil pointer) is a tool used to sharpen drafting pencils and leads. There are several types. The most common type consists of several small blades that sharpen the tip of the lead when the pointer is rotated.

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6. Drafting pencils and lead holders are tools used to create technical drawings. The lead holders can store lead and use a range of lead types. Both the leads and the drafting pencils range in type from hard to soft, creating dark or light lines.
7. Drafting erasers and erasing shields are tools used in combination to make corrections on blueprints. Erasing shields are metal sheets with a series of openings and holes ranging in size and shape to accommodate different geometries.
8. A dusting brush is a tool used to clear technical drawings of erasures. Any marks not completely cleared may show up on the blueprints (reproductions). Technical drawings typically go through several iterations (versions) before the final drawing is completed.
9. A ***protractor*** is a tool used to measure and lay out angles on drawings. It is circular or semicircular and is made from clear plastic with a full range of degrees engraved around the circumference.
10. A ***scale ruler*** is a tool formed from a strip of wood, aluminum, or plastic, with a straightedge graduated in inches or millimeters that is used for measuring and drawing. Drafting scales are typically triangular-shaped rulers with a different scale on each face, with up to 12 different scales (dimensions): two to four scales per side. Scales are ratios designed to create drawings and models to exact sizes. Three types of scales are architect, engineer, and mechanical drafter types.

Teaching Strategy: *Many techniques can be used to help students master this objective. Use VM–A and VM–B to review. Have students create individual technical drawings of the classroom that include four walls and a floor plan. Assign LS–A.*

Objective 2: Interpret blueprint symbols, notes, and abbreviations.

Anticipated Problem: Which symbols, notes, and abbreviations are used on blueprints?

II. Blueprint symbols, notes, and abbreviations

A. Basic blueprint information

1. Each drawing has a title block that includes the name of the company or organization that produced the drawing, the final issue date, and general information about the drawing or project. It also contains a print name and reference number or letter. The title block contains any specific information required to interpret the drawings.
2. The drawing's reference number identifies the drawing in a set. There are usually multiple drawings (or sheets) in a project set. Drawings that convey similar information are grouped with a common number or letter.
3. A cover page (or sheet) lists all the drawings with their reference numbers that exist in the full set. All the symbols, terms, notes, and abbreviations used on the blueprints are listed and defined on the cover page.

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4. The ***drawing scale*** is the size of the drawing relative to the actual object it represents. The scale of the drawing is reduced or enlarged by a specific amount (called "scale"). Scale is shown on a drawing as the length of the drawing separated by a colon (":") and followed by the actual length of the real object. It is a reference and does not ensure that the drawing is printed exactly to that scale. Dimensions on the drawing are used for fabrication and model making. Blueprint drawings are typically drawn in the following scales:
   a. SI units—1:20, 1:50, and 1:100
   b. Imperial or U.S. units—¼-inch or ⅛-inch
   c. Detail scales—1:1, 1:5, 1:10, and 1:20
   d. Component scales—1:20, 1:10, and 1:5
   e. Floor plans—1:40 and 1:50
   f. Location plot plans—1:80, 1:100, and 1:200
   g. Block plans and city maps—1:1000, 1:1250, and 1:2500
   h. Ordinance survey maps—1:100000, 1:50000, and 1:10000

B. Symbols

1. A ***symbol*** is a graphic element that represents an item on a technical drawing. Several types are used on technical drawings: material symbols, reference or specification symbols, and graphic symbols that represent objects. The material and graphic symbols may look different in an elevation versus a plan, section, or detail drawing.
2. Material legends include all the materials used in the drawing. The symbol is located in a small rectangle with the name next to it. A material symbol is a graphic image used to fill in the outline of a shape or object on the drawing and represents the object's actual material.
3. Symbols are used to reference other drawings or schedules. These symbols have a coded letter and/or number that direct a person to the correct drawing. Reference symbols typically remain the same in all types of drawings. The number and/or letter are enclosed in a circle, rectangle, triangle, or other basic geometry.
4. Most of the symbols used in elevation to communicate design specifics look like the actual material or object. The symbols used in section show the object as if it were sliced in half and represent the composition of the object. Symbols used to represent an object on a plan usually look like the object and most of the construction information is represented graphically.

C. Notes

1. Standard notes and symbols are used on blueprints and technical drawings in conjunction with plan, elevation, section, and detail drawings. The drafter, architect, and engineer use symbols and terminology (text or notes or abbreviations) to communicate design specifications. Symbols help with clarity and organization on blueprints.
2. Notes are used with symbols to clarify drawing features and to call out specifications. The notes include terminology used to describe or explain a design

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feature or part. Notes have leaders that extend directly from the note to the location where it applies. Notes are as short as possible. An example of a note used for a door specification would be "SOLID MAPLE WOOD DOOR."

Teaching Strategy: *Many techniques can be used to help students master this objective. Use VM–C and VM–D to review. Before students begin their scale drawings, you may need to review solving proportions. Using the drawing created in Objective 1, have the students apply appropriate symbols and terms to that set of drawings. Students could also add symbols, notes, and abbreviations to any set of existing drawings. Assign LS–B.*

Objective 3: Create built models.

Anticipated Problem: How are models built from blueprints or CADD specifications?

III. Building models

A. Blueprints—Prints include all the drawings necessary to build a model. This typically includes a plan, an elevation of each side (four), and a top or bottom view—if necessary. The prints must include a scale reference to build a model to an exact size. Making several copies (blueprints) of the drawings is a good idea.

B. Materials—Model materials include soft wood (e.g., basswood), foam core, and mat board. Mat board is common, is easy to cut and glue, and is available in many colors. However, white is typically used. Other required tools are:

1. Quick-drying inexpensive glues (e.g., standard white school glue) work well for model building.
2. An X-acto® (or similar) knife is required to cut the model building material cleanly. A utility knife may be used.
3. A scale ruler ensures all the dimensions are to the correct scale.
4. A cutting board is the surface used to size all the model materials. It keeps knives sharp and protects the table surface.
5. A straightedge, such as a metal ruler, is used to make straight lines when drawing and cutting shapes.

C. Scale selection—Once materials and tools are assembled, an appropriate scale is selected for the built model. Scale selection depends on the following factors:

1. Actual size of the object
2. Available space
3. Amount of detail to be shown
4. Amount of material required

Teaching Strategy: *Many techniques can be used to help students master this objective. Use VM–E to review sample built models. Have the students build scaled models of the drawings they created in objective one. Assign LS–C.*

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Review/Summary. Use the student learning objectives to summarize the lesson. Have students explain the content associated with each objective. Student responses can be used in determining which objectives need to be reviewed or taught from a different angle. Questions at the ends of chapters in the textbook may be used in the Review/ Summary.

Application. Use the included visual master(s) and lab sheet(s) to apply the information presented in the lesson.

Evaluation. Evaluation should focus on student achievement of the objectives for the lesson. Various techniques can be used, such as student performance on the application activities. A sample written test is provided.

Answers to Sample Test:

Part One: Matching

1. e
2. a
3. f
4. b
5. d
6. c
7. g

Part Two: True/False

1. T
2. T
3. F
4. T
5. T
6. F

Part Three: Short Answer

1. Scale selection for a built model depends on the following factors:
   a. Actual size of the object
   b. Available space
   c. Amount of detail to be shown
   d. Amount of material required
2. Blueprints contain the following information via symbols, notes, and abbreviations:
   a. Scale of the drawing
   b. Height, width, and length dimensions
   c. Symbols and notations
   d. Multiview detailed sketches of objects

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Sample Test

Name _____

Blueprint Reading

Part One: Matching

Instructions: **Match the term with the correct definition.**

a. T-square
b. drawing scale
c. lead pointer
d. scale ruler
e. blueprints
f. protractor
g. blueprint reading

_____1. Reproductions of technical drawings that use a contact print process on light-sensitive material

_____2. A tool that consists of a head and a blade (or straightedge) used to draw straight lines

_____3. A tool used to measure and lay out angles on drawings

_____4. The size of the drawing relative to the actual object it represents

_____5. A tool formed from a strip of wood, aluminum, or plastic with a straightedge graduated in inches or millimeters that is used for measuring and drawing

_____6. A tool used to sharpen drafting pencils and leads

_____7. The interpretation of the language—symbols, notes, and abbreviations—found on construction, schematics, and wiring diagrams.

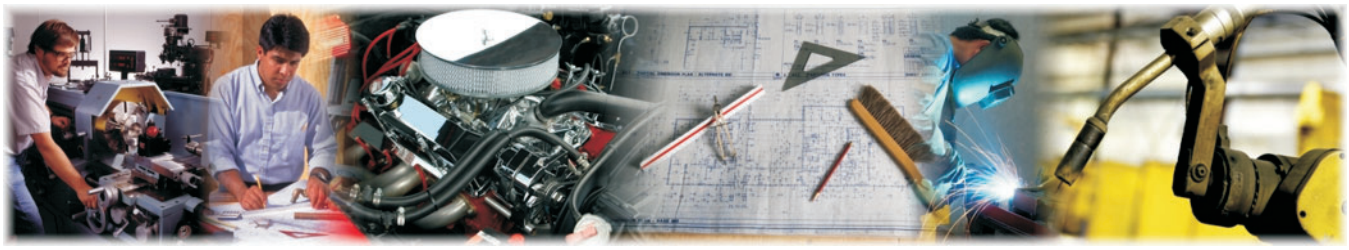
Part Two: True/False

Instructions: **Write *T* for true or *F* for false.**

_____1. A quick-drying inexpensive glue works well for model building.

_____2. Notes are used with symbols to clarify drawing features and to call out specifications.

_____3. It is not necessary to indicate the scale of a blueprint.



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_____4. Standard terms and symbols are used on blueprints (technical drawings).

_____5. The two standard triangles used for drafting tasks are the 60-90 degree and 45-degree triangles.

_____6. A cutting board is a hard surface that provides a smooth flat surface for drafting.

Part Three: Short Answer

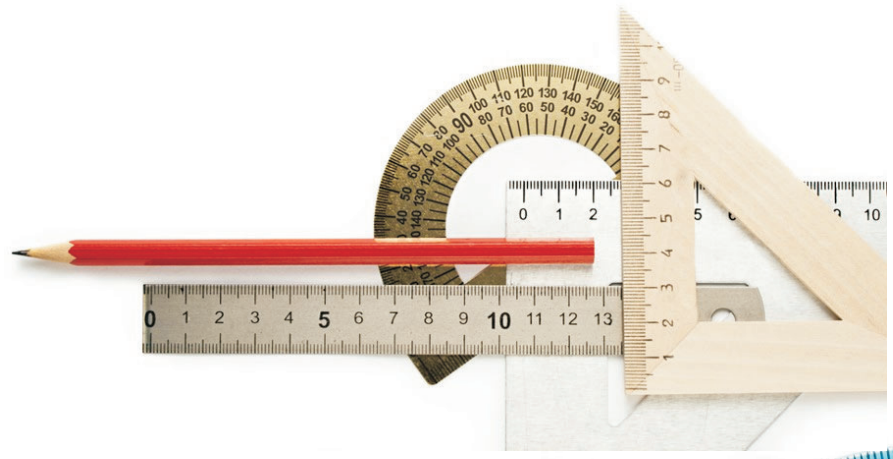
Instructions: **Answer the following.**

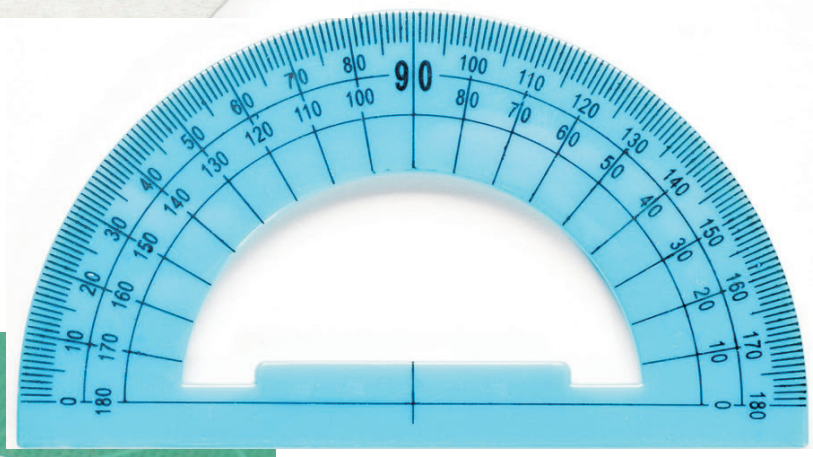
1. List the four scale selection factors for a built model.

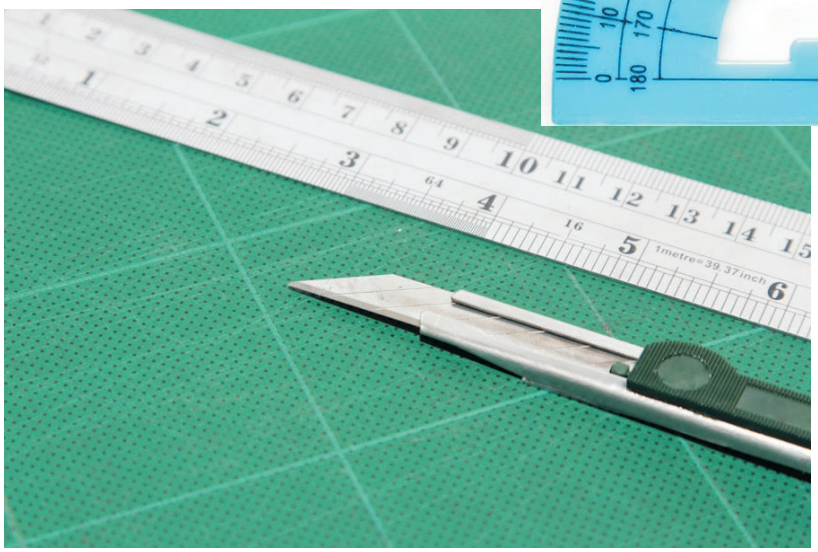
2. List the information blueprints provide through symbols, notes, and abbreviations.

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DRAFTING TOOLS—PROTRACTOR, STRAIGHTEDGE, CUTTER, AND CUTTING BOARD

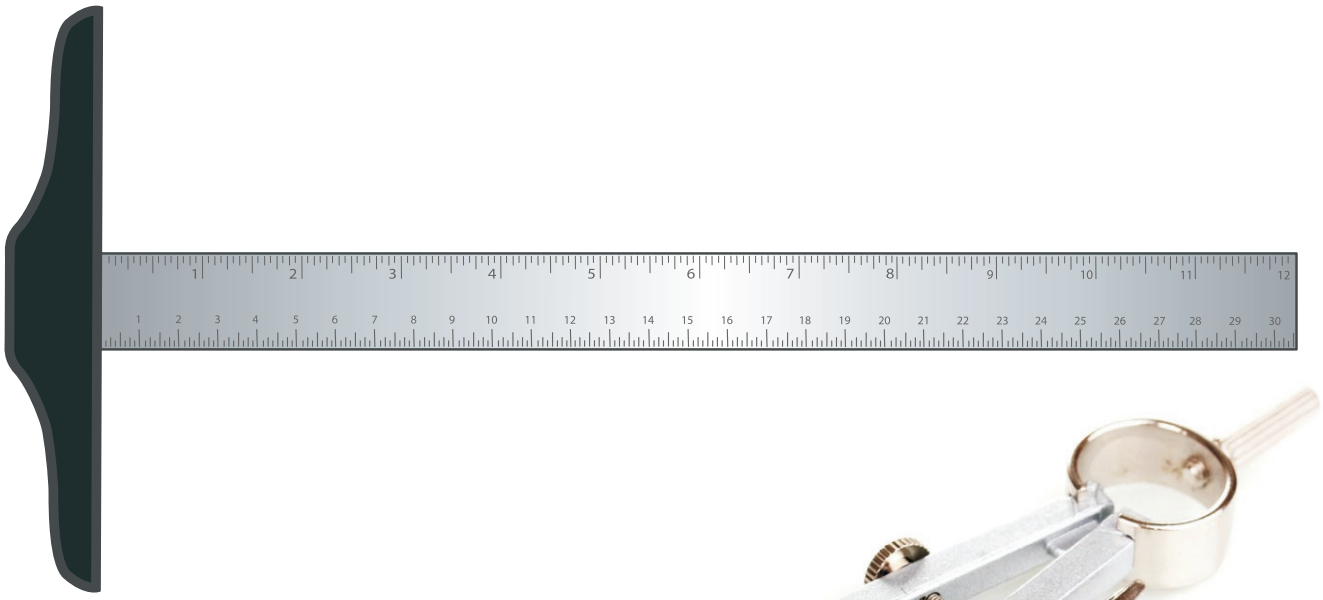






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DRAFTING TOOLS—T-SQUARE, COMPASS, AND SCALE RULER

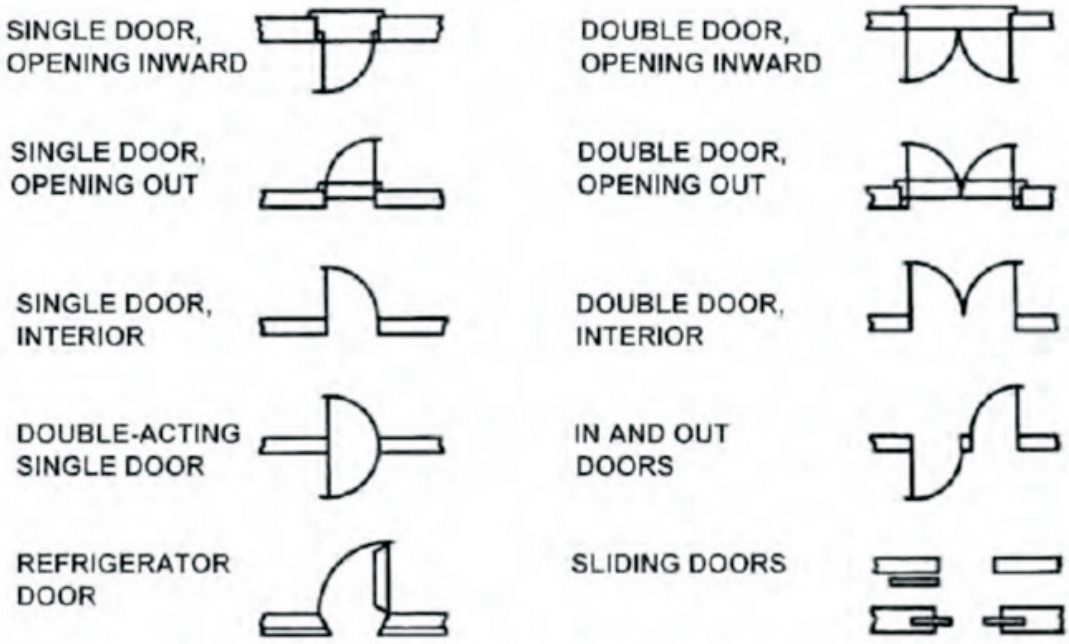




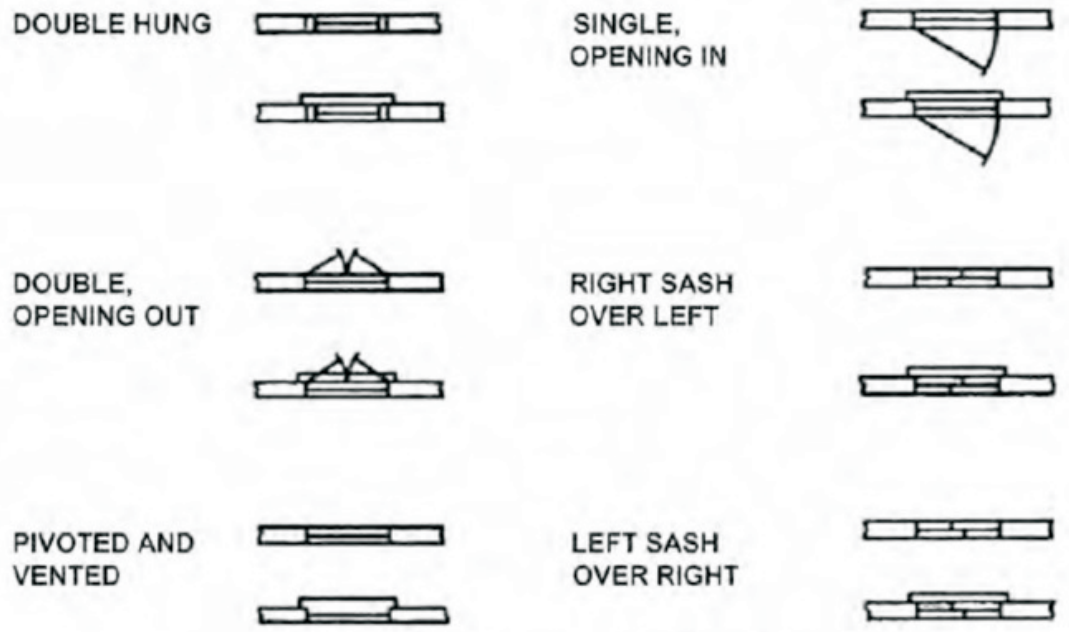


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WINDOW AND DOOR SYMBOLS



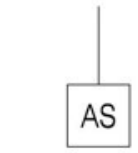
DOOR SYMBOLS



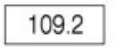
WINDOW SYMBOLS

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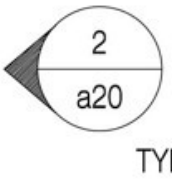
DRAFTING (CADD) SYMBOLS



WALL TYPE



DOOR TAG



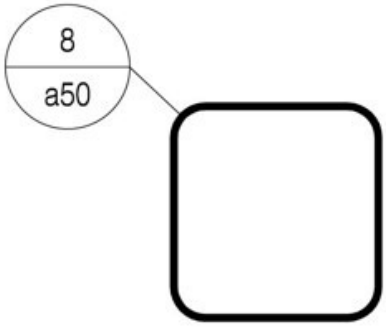
ELEVATION SYMBOL



EQUIPMENT TAG



DETAIL SYMBOL (SECTION)



DETAIL SYMBOL (PLAN)

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BUILT MODEL

Blueprints include a scale reference to build a model to an exact size for a home or a property development. Models are constructed of soft wood, foam core, or mat board.





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LS–A

Name _____

Create a Technical Drawing

Purpose

The purpose of this activity is to produce a technical drawing (blueprint).

Objectives

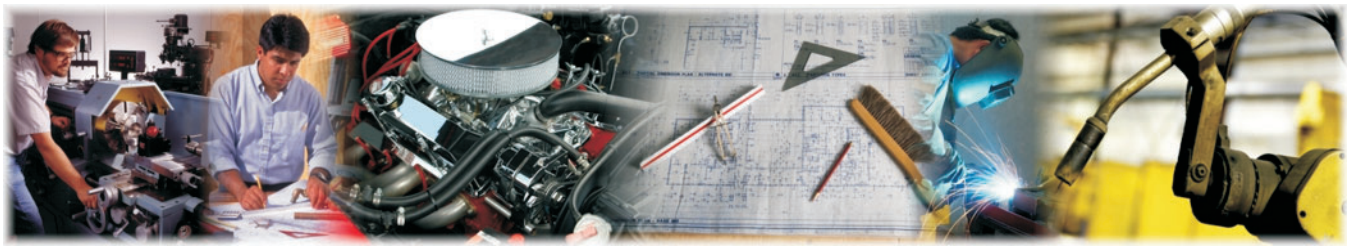
1. Practice using manual or CADD blueprint materials and tools.
2. Sketch a floor plan with dimensions.
3. Sketch four elevations with dimensions.
4. Re-draw the sketches to scale using manual or CADD tools.

Materials

- drafting pencil
- drafting paper
- drawing board
- scale ruler
- triangles
- T-square
- tape measure
- computer
- CADD software
- printer
- tape measure

Procedure

1. Work independently.



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2. Assemble your materials.
3. Produce a set of classroom drawings that include:
    a. A floor plan
    b. Four elevations
4. First, take measurements of all the main features of your classroom, including:
    a. Room dimensions
    b. All windows
    c. All doors
    d. Any additional structures (e.g., pillars and heating units)
5. Second, sketch a floor plan of the classroom. Then add the dimensions of the room to the sketch.
6. Third, sketch all the elevations, and add the required dimensions.
7. Finally, re-draw all the sketches with your manual drafting or CADD tools at a set scale. Discuss the appropriate drawing scale with your instructor. Plan to fit your classroom drawing on one 11- × 17-inch sheet of paper at a ½-inch = 1-foot 0-inch scale.
8. When finished, ask your instructor to review your project. Then turn in your completed drawing to your instructor.

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LS–B

Name _____

Create a Technical Drawing—Blueprint with Symbols, Graphics, and Dimensions

Purpose

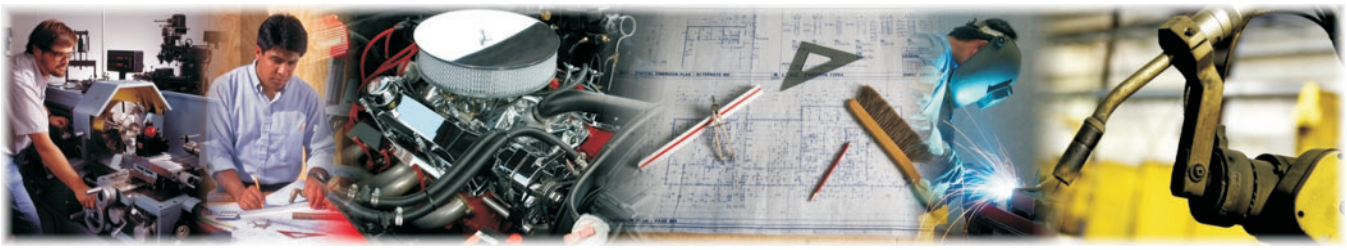
The purpose of this activity is to produce a technical drawing (blueprint) with symbols, graphics, and dimensions.

Objectives

1. Draw the appropriate graphic symbols for all the windows and doors.
2. Add the appropriate symbols for specifications (e.g., windows and doors).
3. Add all dimension line information (e.g., including extension lines).

Materials

- drafting pencil
- drafting paper
- drawing board
- scale ruler
- triangles
- T-square
- drawing produced in Objective 1 (LS–A)
- computer with printer
- CADD software
- printer



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Procedure

1. Work independently. Your goal is to add the appropriate symbols, graphics, and dimensions to the drawing set you began in LS–A.
2. Assemble your materials.
3. To finish the drawing set:
   a. First, draw the appropriate graphic symbols for all windows and doors.
   b. Next, add the appropriate symbols used for specifications, such as window and door tags and elevation symbols.
   c. Finally, add all the necessary dimension line information. Ensure that the dimensions are clear and accurate. All dimension lines and extension lines should match the exact locations of your original dimension measurements.
4. Ask your instructor to review your drawing set for accuracy.
5. Make any edits or modifications. Then turn in your drawings to your instructor.

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Name _____

Build Models from Technical Drawings

Purpose

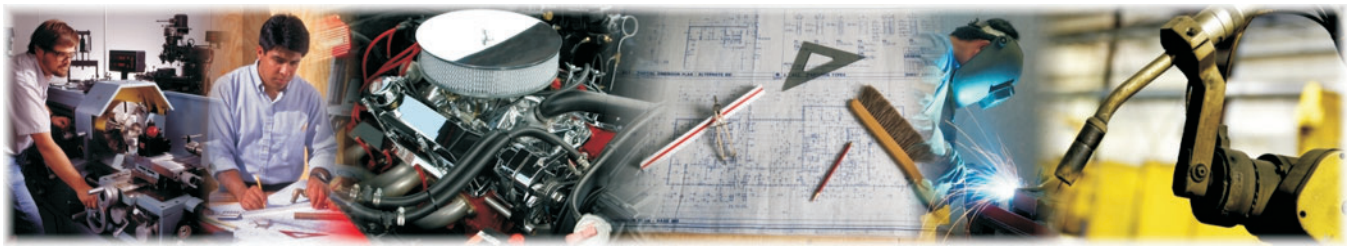
The purpose of this activity is to produce a model from technical drawings.

Objectives

1. Determine an appropriate scale for your model with your instructor.
2. Re-draw the plan onto your model material using the dimension measurements.
3. Cut the model pieces and glue together (e.g., floor plan and all elevations).
4. Assemble the model.

Materials

- pencil
- paper
- cutting board
- glue
- X-acto® (or similar) knife
- straightedge
- scale ruler
- plan print and each elevations
- model building material, such as mat board
- drawing set created in LS–A and LS–B



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Procedure

1. Work independently. Your goal is to build a model of your classroom using the technical drawing set you created in LS–A and LS–B.
2. Assemble your materials.
3. To build your classroom model:
   a. First, discuss the scale of the model with your instructor. For example, you may decide to build the model at ½" = 1' 0" scale. At this scale, a classroom of 20' × 20' will have a model of 10" × 10".
   b. Next, re-draw the floor plan onto your model material using the dimension measurements.
   c. Draw each elevation onto the model material using dimension measurements.
   d. Ensure the dimensions are correct. Then cut the model pieces.
   e. Optional: Ask your instructor to review your model pieces for accuracy prior to gluing the model together.
   f. Assemble the model by gluing all parts together.
4. Ask your instructor to review your finished product.

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