

# Principles of Technical Drawing

## Lesson Overview

**Media:** Video (32 minutes)

**Seat Time:** 5 Classes | 450 minutes teaching

**Goal:** To understand the importance of technical drawings and how they are used.

**Description:** Students will be introduced to the basics of engineering drawings and will use these skills to construct their own drawings which meet standards and best practices.

### Objectives:

1. To understand and interpret engineering drawings using orthographic projection.
2. To differentiate between dimensions and tolerances and how they are used.
3. To create drawings suitable for manufacturing.
4. To identify the different types of technical drawings and how they are used in industry.

## Lesson Plan

### Class 1

#### Class Overview:

- *Introduction to Technical Drawing* Video Segment
- Action Plan
- Vocabulary Handout
- Key Concepts
- Introduction to Technical Drawing Check for Understanding
- Modelmaking & Technical Drawing Activity

#### Essential Questions:

1. What is a technical drawing or print?
2. Why are they important to engineering and how are they used?

#### Step 1: Bell Ringer:



- **Matching Game:** Distribute photos of a mechanical component to half the class and the corresponding technical drawing to the other half. Students need to match the drawings with the photos, establishing partners for the activity later.

#### Step 2: Distribute the **Action Plan**, **Vocabulary Handout** and **Key Concepts**.



- The **Action Plan** lays out a list of tasks for students to complete during the lesson.
- The **Vocabulary Handout** is a list of terms used throughout the lesson.
- The **Key Concepts** is an outline which identifies the main ideas presented in the lesson which students can fill in to aid in note taking during the lesson.

#### Step 3: Show the **Introduction to Technical Drawing** video segment.



- This video is six minutes long.
- Be sure students utilize the **Key Concepts** for this segment of the lesson.

#### Step 4: Administer the **Introduction to Technical Drawing Check for Understanding**.



- The Check for Understanding is a short review of the content presented in the segment.

# Principles of Technical Drawing

## Lesson Plan

### Class 1 (continued)

**Step 5:** Students should begin the **Modelmaking & Technical Drawing Activity**.



- In groups of two, students will sculpt a three-dimensional shape and create a drawing of their work. Their partner will attempt to recreate their sculpture from the drawing alone.

**Step 6: Exit Ticket:**



- **Quick Write:** Students will write four to six sentences in response to the following prompts:
  - Describe how you felt recreating your partner's model. Did you find it easy to understand their drawing or was it a frustrating experience? Was all necessary information included?
  - List three things you liked about their drawing. What parts made it easy for you to mimic their design?
  - List three things you would improve or change on your own drawing if you had to redo this activity. What might make it easier for them to understand your design?

### Class 2

**Class Overview:**

- *Types of Technical Drawings* Video Segment
- *Geometry Review* Video Segment
- Action Plan
- Key Concepts
- *Types of Technical Drawings* Bell Ringer Activity
- *Types of Technical Drawings* Check for Understanding
- *Geometry Review* Check for Understanding
- *Identifying Technical Drawings* Activity

**Essential Questions:**

1. What are the different types of technical drawing and what are they used for?
2. Why is an understanding of geometry important to technical drawings?

**Step 1: Bell Ringer:**



- Distribute the **Types of Technical Drawings Bell Ringer Activity**.
  - Students will differentiate between the types of technical drawings used in engineering.

**Step 2:** Show the **Types of Technical Drawings** video segment.



- This video is five minutes long.
- Be sure students utilize the **Key Concepts** for this segment of the lesson.

**Step 3:** Administer the **Types of Technical Drawings Check for Understanding**.



- The Check for Understanding is a short review of the content presented in the segment.

**Step 4:** Show the **Geometry Review** video segment.



- This video is six minutes long.
- Be sure students utilize the **Key Concepts** for this segment of the lesson.

# Principles of Technical Drawing

## Lesson Plan

### Class 2 (continued)

**Step 5:** Administer the **Geometry Review Check for Understanding**.



- The Check for Understanding is a short review of the content presented in the segment.

**Step 6:** Students should begin the **Identifying Technical Drawings Activity**.



- Students will work with a partner to identify important information contained in various types of technical drawings.

**Step 7: Exit Ticket:**



- Have students revisit the **Types of Technical Drawings Bell Ringer Activity** and revise their definitions and examples as needed.

### Class 3

**Class Overview:**

- *The Alphabet of Lines* Video Segment
- Action Plan
- Key Concepts
- The Alphabet of Lines Check for Understanding
- Shadow Puppet Projections Activity

**Essential Questions:**

1. Why is a standardized alphabet of lines important for technical drawings?
2. What do the different lines mean and how are they used by drafters?

**Step 1: Bell Ringer:**



- **Quick Draw:** Students will draw any object in three-dimensions on a sheet of paper.
  - In small groups, they should discuss their choice and why they think it is a three-dimensional drawing.

**Step 2:** Show **The Alphabet of Lines** video segment.



- This video is five minutes long.
- Be sure students utilize the **Key Concepts** for this segment of the lesson.

**Step 3:** Administer **The Alphabet of Lines Check for Understanding**.



- The Check for Understanding is a short review of the content presented in the segment.

**Step 4:** Students should begin the **Shadow Puppet Projections Activity**.



- Students will create a multi-view drawing of an object found in their classroom using orthographic projection by tracing shadows.

**Step 5: Exit Ticket:**



- **Quick Write:** Students will respond to the following prompt in four to six sentences:
  - Select one of the lines in the alphabet (Visible, Hidden, Phantom, Center, Section, Viewing-Plane or Cut-Plane) and explain how it is used in technical drawings.

# Principles of Technical Drawing

## Lesson Plan

### Class 4

#### Class Overview:

- *Dimensions & Tolerances* Video Segment
- Action Plan
- Key Concepts
- Dimensions & Tolerances Check for Understanding
- Tolerance Brochure Project

#### Essential Questions:

1. What is the difference between a dimension and a tolerance?
2. What is geometric dimensioning and tolerancing?

#### Step 1: Bell Ringer:



- Have students review the set of provided tolerances (plus/minus dimensions) and write the type of machine or application where they might see it.
  - +/- 0.125" - > outdoor planter box
  - +/- .0005 inches - > jet engine

#### Step 2: Show the **Dimensions & Tolerances** video segment.



- This video is eight minutes long.
- Be sure students utilize the **Key Concepts** for this segment of the lesson.

#### Step 3: Administer the **Dimensions & Tolerances Check for Understanding**.



- The Check for Understanding is a short review of the content presented in the segment.

#### Step 4: Students should begin the **Tolerances Brochure Project**.



- Students will create a brochure which highlights examples of different tolerances or dimensions.

#### Step 5: Exit Ticket:



- *Think, Pair, Share*: Students will get into groups of two to consider the prompt provided, then discuss their responses before sharing with the class.
  - Identify scenarios where a dimension would need to be specified to the tenths, hundredths, thousandths and ten-thousandths place and explain why the scenario would require this amount of precision.

### Class 5

#### Class Overview:

- *Drafting Tools & Techniques* Video Segment
- Action Plan
- Key Concepts
- Drafting Tools & Techniques Check for Understanding
- Drafting Practice Activity

#### Essential Questions:

1. What tools are used to create drawings manually?
2. How are technical drawings created with paper and pencil?



# Principles of Technical Drawing

## Lesson Plan

### Class 5 (continued)

#### Step 1: Bell Ringer:



- Provide students with a set of drawings/project plans.
  - Students will have three minutes to review the drawings/plans and discuss overall dimensions, manufacturing type, tools required, materials and what they liked or did not like about each one.

#### Step 2: Show the **Drafting Tools & Techniques** video segment.



- This video is four minutes long.
- Be sure students utilize the **Key Concepts** for this segment of the lesson.

#### Step 3: Administer the **Drafting Tools & Techniques Check for Understanding**.



- The Check for Understanding is a short review of the content presented in the segment.

#### Step 4: Students should begin the **Drafting Practice Activity**.



- Students will create a multi-view part drawing from scratch from an object in the classroom suitable for a manufacturer to reproduce the object.

#### Step 5: Exit Ticket:



- *Quick Draw*: Give students two minutes to sketch out a technical drawing of an object in the classroom.

### Class 6

#### Class Overview:

- Action Plan
- Principles of Technical Drawing Final Assessment
- Tolerance Brochure Project

#### Essential Questions:

1. What opportunities exist for those proficient at technical drawing?
2. Why are technical drawings useful?

#### Step 1: Bell Ringer:



- Project the CAD drafting screen on the board and hover over various tools and have students share the correct name and function.

#### Step 2: Administer the **Principles of Technical Drawing Final Assessment**.



- The Final Assessment is a comprehensive assessment covering material throughout the entire lesson.

#### Step 3: Students should complete the **Tolerance Brochure Project**.



- Students will create a brochure which highlights examples of different tolerances or dimensions.

#### Step 4: Exit Ticket



- Students should turn in all their completed activities and projects.



**NOTE:** If you see this icon, the item is available to be completed interactively on iCEV.

# Principles of Technical Drawing

## Activities

### **Modelmaking & Technical Drawing**

Students will create a drawing detailed enough for someone else to recreate their model without having seen it or communicating with the student. This activity introduces students to the importance of standardized technical drawings and improves their visual communication skills.

#### **Materials:**

- Modeling clay
- Toothpicks for sculpting details
- Graph paper, ruler, pencil

#### **Accommodations:**

Provide students with additional time to create their drawings or allow them to work in pairs to create their sculpture and drawings, then swap with another pair.

#### **Modifications:**

Provide students with pre-selected objects and a drawing with some information already sketched.

#### **Extension:**

Students can complete a second round of sculpting and drawing, then discuss and compare how the process became more streamlined and if their second attempt produced a better copy than the first.

### **Shadow Puppet Projections**

Students will create a multi-view drawing of an object found in your classroom using orthographic projection by tracing shadows. Consider lowering the lights in the classroom to make shadows easier to see. Completing this activity provides students the opportunity to practice using orthographic projection.

#### **Materials:**

- Graph paper, ruler, pencil
- Masking tape
- Flashlight

#### **Accommodations:**

Students can be allowed more time to create their engineering drawings. The instructor can also select the object and set up the light source and paper to make it easier to trace.

#### **Modifications:**

Instead of creating a proper multi-view drawing with a title block, students can focus on a single projected view.

#### **Extension:**

Dimensions and tolerances can be added to make a drawing suitable for manufacturing or a CAD model could be created off of the drawing.

# Principles of Technical Drawing

## Activities

### **Drafting Practice**

Students will create a multi-view part drawing, from scratch, from a object in your classroom suitable for a manufacturer to reproduce that object. Students completing this activity will develop an understanding for the steps needed to completed a multi-view drawing.

#### **Materials:**

- Graph paper, ruler, pencil
- Compass
- Triangle
- Calipers (*optional*)

#### **Accommodations:**

The instructor can select an easier object to draw or more time can be allowed.

#### **Modifications:**

Students can be provide with a list of relevant measurements for a selected object or be asked to only create a single orthographic view in their drawing, rather than three.

#### **Extension:**

Students could design a custom part and create a proper engineering drawing of their design. The finished drawing could also be used for manufacturing, partnering with a CTE/Shop class to actually fabricate the part based on the technical drawing.

### **Identifying Technical Drawings**

Students will work with a partner to identify important information contained in various types of technical drawings. Sample drawings of mechanical components can be found on the websites for industrial components or robotics, like McMaster-Carr<sup>®</sup>, SDP-SI<sup>®</sup>, AndyMark<sup>®</sup> or REV Robotics<sup>®</sup>. This activity exposes students to different types of technical drawings and allows students to consider the different uses for each.

#### **Accommodations:**

Students can be allowed more time or additional instructional support while working on their infographics.

#### **Modifications:**

The examples section could be excluded or specific examples for the further research can be provided.

#### **Extension:**

Students can select a type of technical drawing and make an additional infographic or poster with further detail. Students could also make a full set of review cards, one for each type of technical drawing, for reference in subsequent lessons.



# Principles of Technical Drawing

## Project

### **Tolerances Brochure**

Students will create a brochure which highlights examples of different tolerances or dimensions. This project provides students the opportunity to explore the details of how a tolerance is used in the engineering field.

#### **Accommodations:**

Instructors can assign easier-to-understand concepts, like a bilateral tolerance over GD&T standards to students which might be struggling. More time or a template can be provided as well.

#### **Modifications:**

The research and examples of specific uses section can be omitted or substituted with a more directed research assignment.

#### **Extension:**

Building on their brochure, student could create a classroom poster showing the appropriate symbols and specifications for the different tolerances shown in the ASME Y14.5 standard for GD&T.

## Career & Technical Student Organizations & Competitions

### **HOSA**

- Medical Innovations

### **SkillsUSA**

- Additive Manufacturing
- Automated Manufacturing Technology
- Engineering Technology/Design
- Technical Drafting

### **IRST Robotics**

### **VEX Robotics**

### **Marine Advanced Technology Education (MATE) International ROV Competition**

### **Team America Rocketry Challenge (TARC)**

### **National Institute of Metalworking Skills (NIMS)**

## Career Connections

### **Career Connections**

Using the **Career Connections Activity** allows students to explore careers associated with this lesson by viewing career interviews with various industry professionals. The career interviews are located on the Select Playlist drop down menu on the lesson page. If Student Licenses are being utilized, students can select the interviews to watch based on your directions. If only a Teacher License is being utilized, show students all of the career interviews and instruct them to only complete the interview form for the required number of interviews. See the **Career Connections Activity** for more details.

- Joel Richard, Mechanical Engineer, Hoover Dam
- Derek Logan, Project Engineer, Nissan Technical Center North America
- Pat Venner, Product Design Engineer, John Deere