

Integrated Education And Training (IET)

Basic Skills Lesson

Mechanical Components/ Mechanical Maintenance Foundations

Developed by the



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Integrated Education and Training Informational Cover Page

Mechanical Components/Mechanical Maintenance Foundations Basic Skills Lesson Plan Overview

Title: Mechanical Components, Mechanical Maintenance Level 1/Foundations

Training Provider: Pennsylvania College of Technology Workforce Development and Continuing Education

Description of Occupational Training: This course is designed to fulfill requirements of the Electrical and Instrumentation Technician Curriculum of PMMI Certification, The Association of Packaging and Processing Technologies. This course is being offered in conjunction with a state approved apprenticeship in Columbia County.

Hours of Training: 144 for state apprenticeship, 60-80 if other offering

Hours of Basic Skills Training: 20

Integrated Education and Training Program Objectives:

- To give incumbent workers an opportunity to improve their skills to meet the needs of local manufactures.
- Skill areas include the assembly, test, startup, repair or upgrade of basic machinery models.

Basic Skills Objectives:

- To give participants the basic academic skills needed to be successful in the Level 1 Mechanical Maintenance course.
- Participants will practice study skills and test taking skills to successfully pass Level 1 of the U.S. Department of Labor and Manufacturers Institute's Skills Certification System.

Intended Audience:

Employees that hold entry level positions with local manufactures and are seeking to improve their skills to become industrial machinery mechanics, machinery maintenance workers, or millwrights. Entry level machine technicians generally need a high school diploma. Training would be appropriate for those functioning at Low Adult Secondary Education Level.

Assessment:

Formative:

- On-going skill and content assessments

Summative:

- TABE® Survey 9/10
- Certification exam

Introduction to the lesson plan layout:

The lesson plan template was designed to capture objectives and activities of each lesson. The lesson plans references both College and Career Readiness Standards and the Foundation Skills Framework.

Process of developing the curriculum

- Talked with instructor to learn about the course and its objectives.
- Observed videos of current class to see flow of lessons and style of presentation.
- Studied text to determine basic skills needed to build an assistive curriculum.
- Conducted research to gain familiarity of the trade.

Mechanical Maintenance Foundations

Lesson Topic	Strategies for Reading a Text
Objective(s)	Students will understand how to read and use text books effectively as a key to academic success.
Length	2 hrs.

Foundation Skills Information

Basic Workplace Skills		Basic Employability		Basic Workplace Knowledge	
	Uses Technology	X	Demonstrates Interpersonal Relations		Applies Health and Safety Concepts
	Observes Critically		Demonstrates Self-Management Strategies		Understands process of product/service
	Listens with understanding		Works in teams		Demonstrates quality consciousness
	Speaks clearly and concisely		Solves Problems		Understands Finances
	Writes Clearly and Concisely		Makes Decisions		Works within Organizational Structure and Culture
X	Reads with Understanding				
	Applies Mathematical Concepts and Operations				
	Locates and Uses Resources				

CCRS (Anchor/Standard/Resource)	Math	Reading	Writing	Language

Materials	<p><u>Pennsylvania College of Technology. Professional Development. Mechanical Maintenance Level 1.</u></p> <p>Handout: How to Read Technical Writing found at http://www.wikihow.com/Read-Technical-Writing.</p>
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Mechanical Maintenance Foundations

Anticipatory Set	Ask students to introduce themselves and share a bit about their work experience. Have they worked in a manufacturing setting before? For how long? What type of work have they done?
Instructional Procedure	<p>Explain that the purpose of this lesson is to become familiar with the text they will be using and to practice reading technical writing.</p> <p>Verbally go over the 7 steps to reading technical writing found on the handout. Have students take turns reading the steps and sharing their thoughts.</p> <p>Do a walk-through of the first chapter, <i>Tools of the Trade</i>. Note the structure: the Objectives, the Trade Terms, the Required Trainee materials.</p>
Guided Practice	Ask students to complete, on their own, the review questions on pgs. 43-45 to practice their knowledge and recall. Have a discussion.
Closure	As a group, go over the review questions and model the skills used to find the correct answers.

Mechanical Maintenance Foundations

Lesson Topic	Reading Comprehension of a Procedural Text
Objective(s)	Students will practice the reading of a procedural text.
Length	2 hrs.

Foundation Skills Information					
Basic Workplace Skills		Basic Employability		Basic Workplace Knowledge	
	Uses Technology		Demonstrates Interpersonal Relations		Applies Health and Safety Concepts
	Observes Critically		Demonstrates Self-Management Strategies		Understands process of product/service
	Listens with understanding		Works in teams		Demonstrates quality consciousness
	Speaks clearly and concisely		Solves Problems		Understands Finances
X	Writes Clearly and Concisely		Makes Decisions		Works within Organizational Structure and Culture
X	Reads with Understanding				
	Applies Mathematical Concepts and Operations				
	Locates and Uses Resources				

CCRS (Anchor/Standard/Resource)	Math	Reading	Writing	Language
		CCR. 1 E		

Materials	<p>PowerPoint: Characteristics of Procedural Writing found at http://mrsjwalrus.edublogs.org/files/2011/04/Procedural-Writing-Powerpoint-15h7x35.pdf</p> <p><i>Pennsylvania College of Technology. Professional Development. Mechanical Maintenance Level 1.</i></p>
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Mechanical Maintenance Foundations

Anticipatory Set	Explain to students that in this lesson they are going to learn about procedural writing. Instruct students to write a paragraph telling someone how to make a peanut butter and jelly sandwich.
Instructional Procedure	<p>Using the PowerPoint presentation, teach, using lecture and discussion, the 7 characteristics of Procedural Writing: 1. Goal is clearly stated. 2. Materials are listed in order of use. 3. Steps are listed in order and are often numbered. 4. The writing uses action words. 5. The writing contains transition words such as first, then, next, finally. 6. There is detailed information on how, where, when. 7. There is a description of things that often includes pictures.</p> <p>On pg. 71 of the text in the Fasteners and Anchors chapter, look at the general procedures for installing blind rivets. Locate and define the action words and transition words.</p>
Guided Practice	Have students exchange their writing with another person and evaluate that person's steps. Make sure the students consider the steps for procedural writing.
Closure	If time and circumstances allow, provide the supplies needed to make peanut butter and jelly sandwiches. Students should make the sandwiches just as the directions dictate.

Mechanical Maintenance Foundations

Lesson Topic	Understanding Visually Complex Information in Text
Objective(s)	Students will learn how to interpret information presented visually. Students will practice simplifying complex graphics while considering details, shapes, colors, text, and other design elements.
Length	2 hrs.

Foundation Skills Information				
Basic Workplace Skills		Basic Employability		Basic Workplace Knowledge
	Uses Technology		Demonstrates Interpersonal Relations	Applies Health and Safety Concepts
X	Observes Critically		Demonstrates Self-Management Strategies	Understands process of product/service
	Listens with understanding		Works in teams	Demonstrates quality consciousness
	Speaks clearly and concisely		Solves Problems	Understands Finances
	Writes Clearly and Concisely		Makes Decisions	Works within Organizational Structure and Culture
X	Reads with Understanding			
	Applies Mathematical Concepts and Operations			
	Locates and Uses Resources			

CCRS (Anchor/Standard/Resource)	Math	Reading	Writing	Language
		CCR. 7 D		

Materials	<p>Handout Understanding Diagrams and Graphs</p> <p>How to make visually complex information easy to understand. Found at: http://vansedesign.com/web-design/visually-complex-information/</p> <p><u>Workplace Skills. Locating Information Career Readiness Preparation</u></p>
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Mechanical Maintenance Foundations

Anticipatory Set	As a beginning exercise, have students complete the two-page handout, <u>Understanding Diagrams and Graphs</u> . Verbally review the answers to the questions and talk about the prolific use of graphs and drawings in manufacturing.
Instructional Procedure	Utilizing information found in the Vaseo Design article, model how to clarify a visually complex graphic. Using a graphic from the practice text, <u>Locating Information</u> , help students consider the following approaches to creating a mental model of a schematic design: segments and sequencing, specialized views, magnification, implied motion, and inherent structures.
Guided Practice	Allow students time to practice their new skills by answering questions in Lesson 10 and 11 of <u>Locating Information</u> .
Closure	Review answers to the practice questions.

Mechanical Maintenance Foundations

Lesson Topic	Understanding Fraction and Decimal Notation
Objective(s)	Students will review math problems involving fractions and decimals with a concentration on application and problem solving.
Length	3 hrs.

Foundation Skills Information				
Basic Workplace Skills		Basic Employability		Basic Workplace Knowledge
	Uses Technology		Demonstrates Interpersonal Relations	Applies Health and Safety Concepts
	Observes Critically		Demonstrates Self-Management Strategies	Understands process of product/service
	Listens with understanding		Works in teams	Demonstrates quality consciousness
	Speaks clearly and concisely	X	Solves Problems	Understands Finances
	Writes Clearly and Concisely		Makes Decisions	Works within Organizational Structure and Culture
	Reads with Understanding			
X	Applies Mathematical Concepts and Operations			
	Locates and Uses Resources			

CCRS (Anchor/Standard/Resource)	Math	Reading	Writing	Language
	4. NF. 1-4			

Materials	<u>Developmental Mathematics. College Mathematics and Introductory Algebra, 8th Edition.</u>
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Mechanical Maintenance Foundations

Anticipatory Set	Administer chapter tests to identify areas of weakness in students. Use results to guide instruction.
Instructional Procedure	Model solving problems in addition, subtraction, multiplication, and division. Use lessons 2.5 and 3.7 to solve problems in a real world context such as installing ceramic tile and calculating the volume of a tank of fertilizer.
Guided Practice	Students should be directed to complete the chapter summaries and review for practice.
Closure	Apply acquired knowledge to solving problems converting fraction notation to decimal notation.

Mechanical Maintenance Foundations

Lesson Topic	Introduction to Mechanical Advantage
Objective(s)	Students will understand the force amplification achieved by using a tool. Students will understand the behind the transmission of input and output used in machine components.
Length	4 hrs.

Foundation Skills Information				
Basic Workplace Skills		Basic Employability		Basic Workplace Knowledge
	Uses Technology		Demonstrates Interpersonal Relations	Applies Health and Safety Concepts
	Observes Critically		Demonstrates Self-Management Strategies	Understands process of product/service
	Listens with understanding		Works in teams	Demonstrates quality consciousness
	Speaks clearly and concisely		Solves Problems	Understands Finances
	Writes Clearly and Concisely		Makes Decisions	Works within Organizational Structure and Culture
	Reads with Understanding			
X	Applies Mathematical Concepts and Operations			
	Locates and Uses Resources			

CCRS (Anchor/Standard/Resource)	Math	Reading	Writing	Language
	7. EE. 4			

Materials	www.khanacademy.org PowerPoint found at http://olympia.osd.wednet.edu . <u>Developmental Mathematics. College Mathematics and Introductory Algebra. 8th Edition</u>
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Mechanical Maintenance Foundations

Anticipatory Set	Show students the Khan Academy videos: Introduction to Simple Machines and Mechanical Advantage Part 2 and 3.
Instructional Procedure	<p>Show students the PowerPoint presentation.</p> <p>Teach students the addition and multiplication principals of solving equations and inequalities by using problems from the <u>Developmental Math text</u>.</p> <p>As a group solve the various equations on the PowerPoint.</p>
Guided Practice	Instruct students to solve equations on page 580-581 in the text book.
Closure	As a wrap up, ask students to reflect on the work they have been doing with levers and pulleys. Ask them to define the relationship between distance and the mechanical advantage. Discuss.

Mechanical Maintenance Foundations

Lesson Topic	Understanding Ratios
Objective(s)	Students will find the fractional notation of ratios. Students will give the ratio of two different measures as a rate. Students will solve applied problems using proportions as a way to understand mechanical power.
Length	3 hrs.

Foundation Skills Information				
Basic Workplace Skills		Basic Employability		Basic Workplace Knowledge
	Uses Technology		Demonstrates Interpersonal Relations	Applies Health and Safety Concepts
	Observes Critically		Demonstrates Self-Management Strategies	Understands process of product/service
	Listens with understanding		Works in teams	Demonstrates quality consciousness
	Speaks clearly and concisely		Solves Problems	Understands Finances
	Writes Clearly and Concisely		Makes Decisions	Works within Organizational Structure and Culture
	Reads with Understanding			
X	Applies Mathematical Concepts and Operations			
	Locates and Uses Resources			

CCRS (Anchor/Standard/Resource)	Math	Reading	Writing	Language
	6. RP.1 6. RP.2			

Materials	<p>Developmental Mathematics. College Mathematics and Introductory Algebra. 8th Edition. Chapter 4.</p> <p>Mathematics at Work (2008). Found at: http://www.achieve.org/files/MathatWork-Manufacturing.pdf</p>
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Mechanical Maintenance Foundations

Anticipatory Set	Administer chapter test to identify areas of weakness in students. Use results to guide instruction.
Instructional Procedure	<p>Explain that a ratio is the quotient of two quantities and that a ratio can be represented by colon or fraction notation. A rate is used to compare two different kinds of measure.</p> <p>Teach students how to solve proportions by equating cross products and dividing on both sides.</p>
Guided Practice	Exercise Set 4.1 provides practice for students.
Closure	Instruct students to read the article titled “Mathematics at Work, Manufacturing.” The article discusses the growing skills gap and the need for multi-skilled employees in advanced manufacturing. The article talks about the different math skills needed on the Toyota production line. Discuss.

Practice Problems

Work and Mechanical Advantage

1. How much work is done on a 10 N block that is lifted 5 meters off the ground by a pulley?

$$\begin{aligned} W &= F \times d \\ &= 10 \text{ N} \times 5 \text{ m} \end{aligned}$$

Answer:

50 joules or N-m

2. Vanessa lifts her book bag 1.5 meters. If the weight of the bag is 12 N, how much work did she do?

$$\begin{aligned}W &= F \times d \\ &= 12 \text{ N} \times 1.5 \text{ m} \\ &= \mathbf{18 \text{ J}}\end{aligned}$$

3. Kisha applied 20N of force to turn an ice cream freezer crank. The crank's resistance was 60 N. What was the mechanical advantage of the crank?

$$\left(AMA = \frac{F_R}{F_E} \right)$$

$$AMA = \frac{60 \text{ N}}{20 \text{ N}}$$

$$AMA = 3$$

4. You lift a 45 N bag of mulch 1.2 meters and carry it a distance of 10 meters to the garden. How much work was done?

$$\begin{aligned} W &= F \times d \\ &= 45 \text{ N} \times 1.2 \text{ m} \\ &54 \text{ joules} \end{aligned}$$

5. Suppose you need to remove a nail from a board by using a claw hammer. If the effort length for a claw hammer is 11.0 cm and the resistance length is 2.0 cm, what is the mechanical advantage?

$$\begin{aligned} IMA &= \frac{\text{Effort Length}}{\text{Resistance Length}} \\ &= \frac{11.0 \text{ cm}}{2.0 \text{ cm}} \\ &= 5.5 \end{aligned}$$

6. A pulley is used to raise a heavy crate. The pulley is such that an input force of 223 N is needed to provide an output force of 1784 N. What is the mechanical advantage of this pulley?

$$\left(AMA = \frac{F_R}{F_E} \right) = \frac{1784 \text{ N}}{223 \text{ N}} = 8$$

7. A mover uses a ramp to load a crate of nails onto a truck. The crate, which must be lifted 1.4 m from the street to the bed of the truck, is pushed along the length of the ramp. If the ramp is 4.6 m long and friction between the ramp and crate can be ignored, what is the mechanical advantage of the ramp?

$$\begin{aligned} \text{IMA} &= \frac{\text{Effort Length}}{\text{Resistance Length}} \\ &= \frac{4.6 \text{ m}}{1.4 \text{ m}} \\ &= 3.3 \end{aligned}$$

Understanding Diagrams and Graphs

Don't skip over diagrams and graphs when reading!

These visual aids provide summaries or can illustrate a complex process; understanding how to read them is a very efficient way to learn material.

When tackling diagrams or graphs, pay attention to:

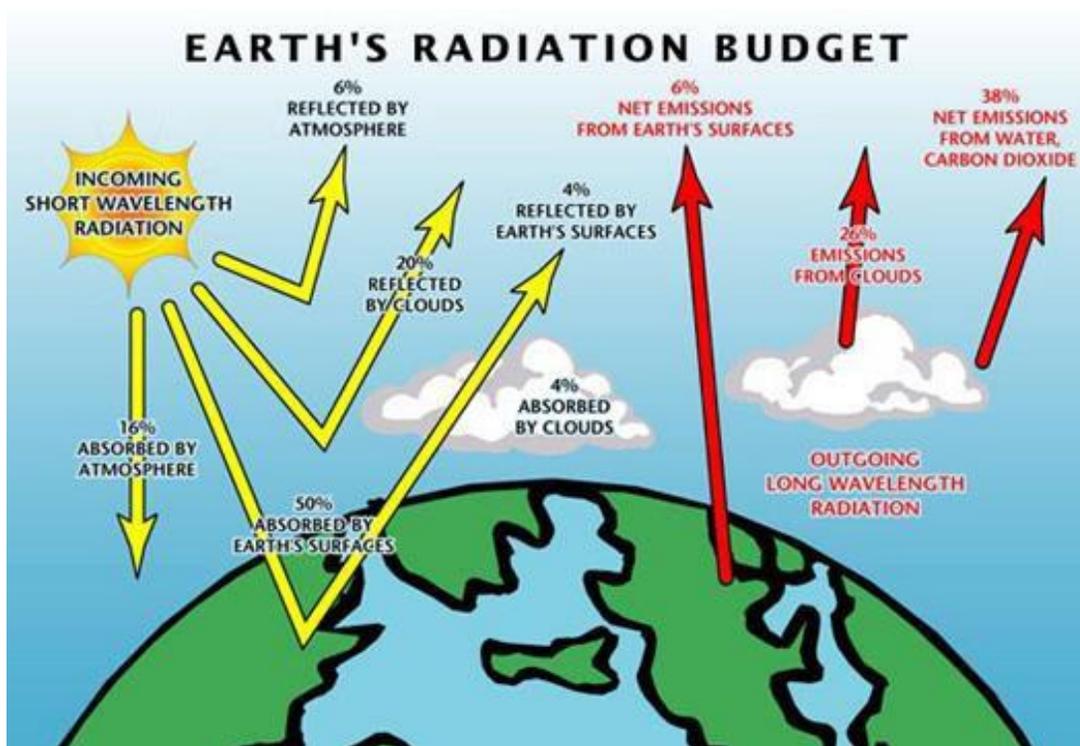
Captions: What clues about the illustration can you gain from the general description?

Labels: Can you define or describe the items labeled? If not, reread the text.

Directionality: Are there arrows, numbers or letters that orient the illustration?

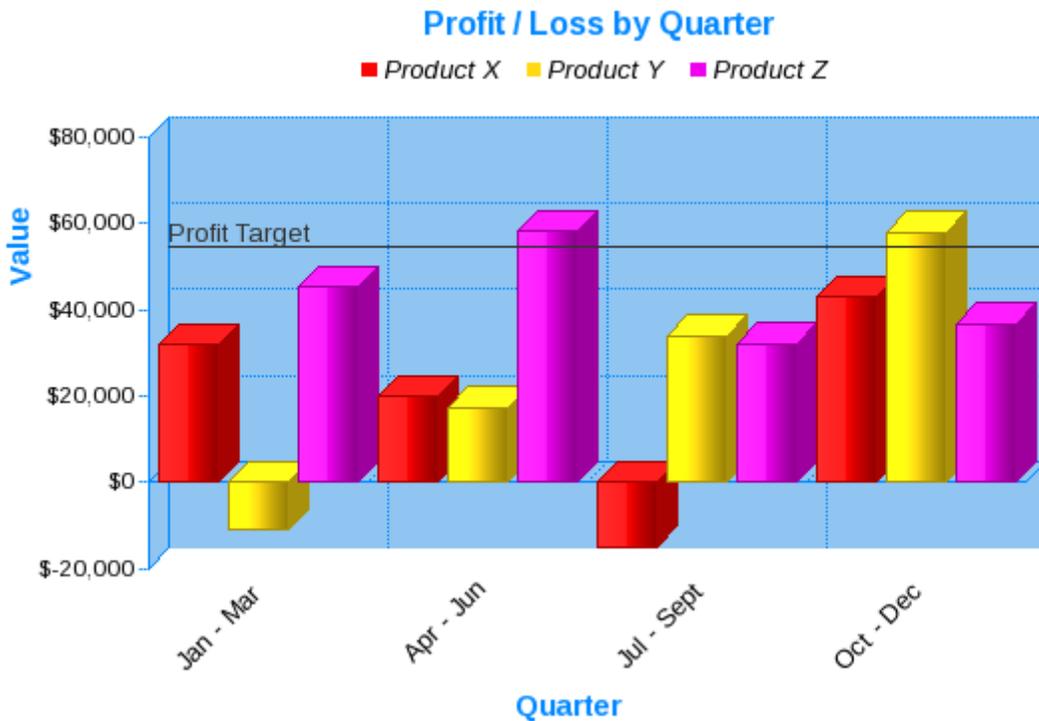
The Big Picture: Do you notice any trends in data? Can you draw conclusions about relationships among items on a diagram?

Review the two examples provided. By answering the questions for each, you'll see how much information can be gleaned from diagrams and graphs.



What information does this diagram provide? How do the arrows help illustrate the process depicted in the diagram? How do the colors of the arrows and the text help organize the facts?

Diagram taken from Calypso Outreach



What information does this graph provide? Note the labels in the X and Y Axis, as well as the location of the “Profit Target” line. What does this graph tell you about the performance of the three products over the course of a year?

Graph taken from [JPowered's History of Bar Charts and Graphs](#)

Studying with Diagrams and Graphs:

Start assigned readings by first reviewing any visual aids provided. This will lay the foundation for understanding the meat of your reading.

Review them again right before class. This will help prepare you for lecture.

After you have completed a reading assignment, **create a visual representation that demonstrates your understanding.** This active learning strategy is an effective way to transfer your new learning to your long-term memory.



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