Career Paths: Mechanical Engineering is a new educational resource for mechanical engineering professionals who want to improve their English communication in a work environment. Incorporating career-specific vocabulary and contexts, each unit offers step-by-step instruction that immerses students in the four key language components: reading, listening, speaking, and writing. Career Paths: Mechanical Engineering addresses topics including materials, simple machines, measurements, basic physics, and career options. The series is organized into three levels of difficulty and offers a minimum of 400 vocabulary terms and phrases. Every unit includes a test of reading comprehension, vocabulary, and listening skills, and leads students through written and oral production.

Included Features:
- A variety of realistic reading passages
- Career-specific dialogues
- 45 reading and listening comprehension checks
- Over 400 vocabulary terms and phrases
- Guided speaking and writing exercises
- Complete glossary of terms and phrases

The Teacher's Guide contains detailed lesson plans, a full answer key and audio scripts. The audio CDs contain all recorded material.
## Scope and Sequence

<table>
<thead>
<tr>
<th>Unit</th>
<th>Topic</th>
<th>Reading context</th>
<th>Vocabulary</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The Mechanical Engineer</td>
<td>Article</td>
<td>assess, broad, design, hardware, improve, manufacture, mechanical engineer, power transmission, specialize in, test</td>
<td>Describing experience</td>
</tr>
<tr>
<td>2</td>
<td>Bearings</td>
<td>Poster</td>
<td>axial, ball bearing, bearing, inner race, journal bearing, outer race, radial, rolling contact bearing, sleeve, straight roller bearing, tapered roller bearing, thrust roller bearing</td>
<td>Making a polite request</td>
</tr>
<tr>
<td>3</td>
<td>Couplings</td>
<td>Textbook Excerpt</td>
<td>align, beam coupling, coupling, flexible, input shaft, offset, output shaft, rigid, sleeve-style coupling, transmit</td>
<td>Making a suggestion</td>
</tr>
<tr>
<td>4</td>
<td>Gears</td>
<td>Encyclopedia Entry</td>
<td>bevel gear, gear, helical gear, mesh, pinion, rack, spur gear, tooth, worm, worm gear</td>
<td>Stating a preference</td>
</tr>
<tr>
<td>5</td>
<td>Drives</td>
<td>Advice Column</td>
<td>belt drive, chain drive, groove, link, sheave, slippage, synchronous rotation, timing belt, v-belt, wedge angle</td>
<td>Making an estimate</td>
</tr>
<tr>
<td>6</td>
<td>Hand Tools</td>
<td>Email</td>
<td>ball peen hammer, box wrench, calipers, hacksaw, Phillips screwdriver, pliers, sledge hammer, slotted screwdriver, socket wrench, vice</td>
<td>Reacting to good news</td>
</tr>
<tr>
<td>7</td>
<td>Machine Tools</td>
<td>Webpage</td>
<td>band saw, broach, CNC mill, drill press, gear shaper, honing machine, lathe, lead screw, machine tool, mill</td>
<td>Talking about necessity</td>
</tr>
<tr>
<td>8</td>
<td>Numbers and Basic Math</td>
<td>Poster</td>
<td>add, divide by, equal, hundred, minus, multiply by, over, plus, subtract, times</td>
<td>Making an apology</td>
</tr>
<tr>
<td>9</td>
<td>Measurements 1</td>
<td>Conversion Chart</td>
<td>foot, gram, imperial, kilogram, length, meter, metric, ounce, pound, weight</td>
<td>Asking for clarification</td>
</tr>
<tr>
<td>10</td>
<td>Measurements 2</td>
<td>Email</td>
<td>Celsius, convert, cubic centimeter, Fahrenheit, fluid ounce, gallon, liter, milliliter, temperature, volume</td>
<td>Checking for certainty</td>
</tr>
<tr>
<td>11</td>
<td>SI Units</td>
<td>Poster</td>
<td>base unit, cubic meter, derived unit, force, joule, kelvin, mass, newton, pascal, SI</td>
<td>Expressing confusion</td>
</tr>
<tr>
<td>12</td>
<td>Large Numbers</td>
<td>Email</td>
<td>cubed, exponent, hundredth, rounding error, scientific notation, significant figure, squared, tenth, thousandth, to the nth power, trailing zero</td>
<td>Giving a warning</td>
</tr>
<tr>
<td>13</td>
<td>Analyzing Quantities</td>
<td>Textbook Excerpt</td>
<td>decimal number, fraction, improper fraction, mixed number, out of, percent, point, quantity, reduce, whole number</td>
<td>Making a prediction</td>
</tr>
<tr>
<td>14</td>
<td>Tables and Graphs</td>
<td>Note</td>
<td>bar graph, column, legend, line graph, pie chart, row, scatter plot, table, x-axis, y-axis</td>
<td>Discussing progress</td>
</tr>
<tr>
<td>15</td>
<td>Simple Machines</td>
<td>Textbook Excerpt</td>
<td>axle, fulcrum, inclined plane, lever, leverage, load, pulley, simple machine, wedge, wheel</td>
<td>Providing an example</td>
</tr>
</tbody>
</table>
# Table of Contents

**Unit 1** – The Mechanical Engineer ................................................. 4

**Unit 2** – Bearings ................................................................. 6

**Unit 3** – Couplings ............................................................... 8

**Unit 4** – Gears ................................................................. 10

**Unit 5** – Drives ................................................................. 12

**Unit 6** – Hand Tools ............................................................... 14

**Unit 7** – Machine Tools ......................................................... 16

**Unit 8** – Numbers and Basic Math ........................................... 18

**Unit 9** – Measurements 1 ........................................................ 20

**Unit 10** – Measurements 2 ...................................................... 22

**Unit 11** – SI Units ............................................................... 24

**Unit 12** – Large Numbers ....................................................... 26

**Unit 13** – Analyzing Quantities ................................................ 28

**Unit 14** – Tables and Graphs .................................................. 30

**Unit 15** – Simple Machines .................................................... 32

**Glossary** .................................................................................... 34
MECHANICAL ENGINEERING

Virginia Evans
Jenny Dooley
Joshua Kern
<table>
<thead>
<tr>
<th>Unit</th>
<th>Topic</th>
<th>Reading context</th>
<th>Vocabulary</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Electricity</td>
<td>Course Description</td>
<td>AC, ampere, charge, circuit, current, DC, electron, ohm, Ohm’s Law, resistance, volt, voltage, watt</td>
<td>Correcting yourself</td>
</tr>
<tr>
<td>2</td>
<td>Basic Physics</td>
<td>Textbook Excerpt</td>
<td>classical mechanics, energy, gravity, matter, motion, Newton’s Laws, physics, quantum field theory, quantum mechanics, relativistic mechanics, speed of light</td>
<td>Correcting an error</td>
</tr>
<tr>
<td>3</td>
<td>Accounting</td>
<td>Email</td>
<td>closed system, consumption, extensive quantity, final, generation, initial, input, intensive quantity, open system, output, system, universal accounting equation</td>
<td>Confirming information</td>
</tr>
<tr>
<td>4</td>
<td>Rate Processes</td>
<td>Textbook Excerpt</td>
<td>diameter, driving force, flow rate, flux, inlet, outlet, pressure, rate, rate process, viscosity</td>
<td>Describing degree</td>
</tr>
<tr>
<td>5</td>
<td>Statistics</td>
<td>Memo</td>
<td>event, independent, intersection, median, mutually exclusive, outcome, population, probability, range, sample, sample space, statistics, union</td>
<td>Describing a lack of experience</td>
</tr>
<tr>
<td>6</td>
<td>Problem Solving</td>
<td>Employee Manual</td>
<td>analysis, approach, attack, brainstorm, iteration, iterative, problem identification, problem solving, procedure, redefine, solution, synthesis</td>
<td>Asking for help</td>
</tr>
<tr>
<td>7</td>
<td>Design Method</td>
<td>Email</td>
<td>assemble, constraint, construct, criteria, detailed design, feasibility study, identify, narrow down, preliminary design, revise, sketch, verify</td>
<td>Asking about progress</td>
</tr>
<tr>
<td>8</td>
<td>Patents</td>
<td>Webpage</td>
<td>claims, design patent, drawing, improvement, intellectual property, milestone, monopoly, ornamental, patent, patent duration, specification, technology, utility patent, witnessed</td>
<td>Making a recommendation</td>
</tr>
<tr>
<td>9</td>
<td>The Scientific Method</td>
<td>Abstract</td>
<td>conclusion, control group, evaluate, experiment, experimental group, hypothesis, independent variable, observation, problem, result, scientific method, testable</td>
<td>Talking about expectations</td>
</tr>
<tr>
<td>10</td>
<td>Materials</td>
<td>Webpage</td>
<td>alloy, ceramics, concrete, glass, lumber, materials science, metal, plastic, polymer, rebar, steel</td>
<td>Listing needs</td>
</tr>
<tr>
<td>11</td>
<td>Properties of Materials</td>
<td>Email</td>
<td>brittle, conductor, ductile, elastic limit, hardness, insulator, luster, malleable, natural, proportional limit, synthetic, tensile, yield strength</td>
<td>Asking for explanation</td>
</tr>
<tr>
<td>12</td>
<td>Force</td>
<td>Textbook Excerpt</td>
<td>coordinate system, cumulative, equilibrium, free-body diagram, magnitude, moment, particle, resultant, rigid body, vector</td>
<td>Expressing confusion</td>
</tr>
<tr>
<td>13</td>
<td>Fluid Motion</td>
<td>Course Description</td>
<td>aerodynamics, buoyancy, drag, fluid, gas, laminar flow, lift, liquid, thrust, turbulent flow, wind tunnel</td>
<td>Explaining differences</td>
</tr>
<tr>
<td>14</td>
<td>Tension and Compression</td>
<td>Report</td>
<td>compression, elastic behavior, elongation, fail, internal force, plastic behavior, shear, strain, stress, stretch, tension</td>
<td>Asking for other options</td>
</tr>
<tr>
<td>15</td>
<td>Career Options</td>
<td>Webpage</td>
<td>consultant, design engineer, engine, generator, inspect, management, manufacturing, professor, public safety, R&amp;D, researcher, technical, tool</td>
<td>Stating a goal</td>
</tr>
</tbody>
</table>
# Table of Contents

**Unit 1 – Electricity** ................................................................. 4  
**Unit 2 – Basic Physics** ............................................................ 6  
**Unit 3 – Accounting** ................................................................. 8  
**Unit 4 – Rate Processes** ............................................................. 10  
**Unit 5 – Statistics** ................................................................. 12  
**Unit 6 – Problem Solving** .......................................................... 14  
**Unit 7 – Design Method** ............................................................ 16  
**Unit 8 – Patents** ................................................................. 18  
**Unit 9 – The Scientific Method** .................................................. 20  
**Unit 10 – Materials** ................................................................. 22  
**Unit 11 – Properties of Materials** ................................................... 24  
**Unit 12 – Force** ................................................................. 26  
**Unit 13 – Fluid Motion** ............................................................... 28  
**Unit 14 – Tension and Compression** .................................................. 30  
**Unit 15 – Career Options** ............................................................. 32  
**Glossary** .............................................................................. 34
## Scope and Sequence

<table>
<thead>
<tr>
<th>Unit</th>
<th>Topic</th>
<th>Reading context</th>
<th>Vocabulary</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Energy</td>
<td>Textbook Excerpt</td>
<td>chemical energy, conserve, convert, elastic potential energy, energy efficiency, energy quality, gravitational potential energy, kinetic energy, mechanical energy, power, thermal energy, work</td>
<td>Making comparisons</td>
</tr>
<tr>
<td>2</td>
<td>Heat and Thermodynamics</td>
<td>Webpage</td>
<td>BTU, burn, combustion, conduction, convection, heat, laws of thermodynamics, radiation, specific heat, thermal conductivity, thermodynamics</td>
<td>Correcting an error</td>
</tr>
<tr>
<td>3</td>
<td>The Combustion Engine</td>
<td>Encyclopedia Entry</td>
<td>combustion chamber, connecting rod, crankcase, crankshaft, cylinder, diesel, engine block, fuel injection pump, gasoline, glow plug, head, piston, piston ring, spark plug, sump, valve</td>
<td>Giving bad news</td>
</tr>
<tr>
<td>4</td>
<td>Two-Stroke Engines</td>
<td>Owner's Manual</td>
<td>burn out, compress, cycle, exhaust, fire, fuel, fuel-to-oil ratio, inlet, mix, revolution, two-stroke engine, two-stroke oil</td>
<td>Stressing a point</td>
</tr>
<tr>
<td>5</td>
<td>Four-Stroke Engines</td>
<td>Webpage</td>
<td>compression stroke, cylinder head, exhaust stroke, exhaust valve, four-stroke engine, head gasket, ignite, intake stroke, intake valve, power stroke, pressure</td>
<td>Troubleshooting problems</td>
</tr>
<tr>
<td>6</td>
<td>Rotational Motion</td>
<td>Textbook Excerpt</td>
<td>angle θ, angular velocity, arc length, center of rotation, degree, pivot point, radian, radius, revolution, rotational motion, RPM, RPS</td>
<td>Asking about benefits</td>
</tr>
<tr>
<td>7</td>
<td>Speed and Torque</td>
<td>Textbook Excerpt</td>
<td>frictional loss, gearset, grind, input torque, output torque, pitch, pitch circle, pitch radius, shift fork, slip, speed, torque, torque ratio, velocity ratio</td>
<td>Expressing concern</td>
</tr>
<tr>
<td>8</td>
<td>Geartrains</td>
<td>Webpage</td>
<td>balanced geartrain, carrier, compound geartrain, direction, idler gear, mesh point, planet gear, planetary geartrain, ring gear, serial, single geartrain, spider, sun gear</td>
<td>Estimating time</td>
</tr>
<tr>
<td>9</td>
<td>CAD</td>
<td>Email</td>
<td>2-D, 3-D, B-rep, CAD, CSG, drafting, exploded view, IGES, manifold model, model, non-manifold model, PDES, photorealistic rendering, technical drawing</td>
<td>Approving a request</td>
</tr>
<tr>
<td>10</td>
<td>Product Lifecycle Management</td>
<td>Article</td>
<td>bottom-up design, concurrent engineering, design strategy, lifecycle assessment, manufacturing process management, material intensiveness, material life extension, material selection, packaging, planned obsolescence, product data management, product lifecycle extension, product management, systems engineering, top-down design</td>
<td>Stating an opinion</td>
</tr>
<tr>
<td>11</td>
<td>Robotics</td>
<td>Résumé</td>
<td>actuator, automation, dexterity, enabling device, end-effector, flow line, hydraulic, joint, manipulator, payload, pendent, pneumatic, robotics, serial robot, work envelope</td>
<td>Describing an experience</td>
</tr>
<tr>
<td>12</td>
<td>Structural Analysis</td>
<td>Course Syllabus</td>
<td>arch, beam, catenary, column, elasticity theory, element, finite element method, mechanics of materials, nonbuilding structure, plate, shell, structural analysis, structural load, support</td>
<td>Providing examples</td>
</tr>
<tr>
<td>13</td>
<td>Failure Theory 1</td>
<td>Textbook Excerpt</td>
<td>brittle failure, buckle, corrosion, creep, deform, ductile failure, failure analysis, failure rate, failure theory, fatigue, fracture, macroscopic failure, metallurgical failure analysis, microscopic failure, thermal shock, yield</td>
<td>Describing unexpected results</td>
</tr>
<tr>
<td>14</td>
<td>Failure Theory 2</td>
<td>Webpage</td>
<td>crash test, DT, extensometer, force deflection, hardness test, materials testing machine, metallographic test, NDT, NFF, stress test, stress-strain curve, weld verification</td>
<td>Scheduling an appointment</td>
</tr>
<tr>
<td>15</td>
<td>Future of Mechanical Engineering</td>
<td>Article</td>
<td>artificial organ, biomechanics, BioMEMS, carbon fiber, composite, FSW, lab-on-a-chip, mechanosynthesis, mechatronics, MEMS, nanotechnology, prosthetic, rivet, rigidity</td>
<td>Asking for more information</td>
</tr>
</tbody>
</table>
# Table of Contents

**Unit 1 – Energy** ................................................................. 4

**Unit 2 – Heat and Thermodynamics** ........................................ 6

**Unit 3 – The Combustion Engine** ........................................... 8

**Unit 4 – Two-Stroke Engines** ............................................... 10

**Unit 5 – Four-Stroke Engines** ............................................... 12

**Unit 6 – Rotational Motion** .................................................. 14

**Unit 7 – Speed and Torque** .................................................. 16

**Unit 8 – Geartrains** ........................................................... 18

**Unit 9 – CAD** ................................................................. 20

**Unit 10 – Product Lifecycle Management** ................................. 22

**Unit 11 – Robotics** ........................................................... 24

**Unit 12 – Structural Analysis** ............................................... 26

**Unit 13 – Failure Theory 1** .................................................. 28

**Unit 14 – Failure Theory 2** .................................................. 30

**Unit 15 – Future of Mechanical Engineering** ............................ 32

**Glossary** ................................................................. 34
Do you want to become a **mechanical engineer**? Mechanical engineers design and build machines. They also assess the quality of existing machines. They adjust and improve the designs as needed. Sometimes mechanical engineers even invent new types of hardware.

A qualified mechanical engineer has an engineering degree. Mechanical engineering is a very broad discipline. Most mechanical engineers specialize in a particular field. Areas of specialization include robotics, thermodynamics, and fluid mechanics.

Students of mechanical engineering study physics and kinematics. Concepts like friction and power transmission are essential. Students learn how to manufacture machines and components. They also learn how to test machines effectively.

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### Vocabulary

Match the words or phrases (1-7) with the definitions (A-G).

1. ___ test
2. ___ broad
3. ___ assess
4. ___ hardware
5. ___ manufacture
6. ___ power transmission
7. ___ mechanical engineer

A. the transfer of energy from one place to another to perform work
B. a person who studies, builds, and works with machines
C. machinery or mechanical components
D. to observe a machine’s operations in order to determine its functionality
E. to build something in a factory
F. involving a wide variety of topics or disciplines
G. to study and evaluate something
Speaking

8 With a partner, act out the roles below based on Task 7. Then, switch roles.

USE LANGUAGE SUCH AS:
Tell me about ...
I worked for ...
What were your ...?

Writing

9 Use the article and the conversation from Task 8 to fill out the engineer's job application.

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Job Application

- What position are you applying for?
- What is your educational background?
- What were your duties at your previous job?
Mechanical engineers deal with many forms of energy. They are primarily concerned with mechanical energy. Engineers harness mechanical energy in order to perform useful work. Understanding energy quality is an essential skill for engineers.

To perform work, mechanical systems must convert energy from one form of mechanical energy to another. For instance, kinetic energy may transform into chemical or electrical energy. Additionally, two types of potential energy are especially important. Gravitational potential energy is released when gravity acts on an object. Elastic potential energy is stored in an object that is stretched or bent. Energy is released as the object springs back into shape. Both of these potential energies are converted into kinetic energy during release.

In addition to mechanical energy, mechanical engineers deal with chemical energy. Chemical energy is released as chemical bonds form and break. Many machines also release thermal energy through the consumption of fossil fuels.

Energy efficiency is a growing concern among both engineers and consumers. Whenever energy is converted, a certain amount of power is always lost. This is unavoidable. However, engineers are always seeking ways to conserve as much energy as possible.

Vocabulary

3 Match the words or phrases (1-8) with the definitions (A-H).

1 ___ work
2 ___ power
3 ___ kinetic energy
4 ___ elastic potential energy
5 ___ energy quality
6 ___ energy efficiency
7 ___ thermal energy
8 ___ gravitational potential energy

A a type of energy that is active or moving
B the transfer of energy, calculated as force times distance
C the energy stored in an object that is stretched or bent
D the rate at which energy is used or transferred
E the energy stored in an object relative to its elevation
F the ratio between the energy used and its useful output
G a type of energy released by the movement of subatomic particles
H the relative ability of a unit of energy to perform work
4 Read the sentence pairs. Choose which word or phrase best fits each blank.

1 **mechanical energy / chemical energy**
   A Batteries use stored ________________________ to power devices.
   B ________________________ is a combination of kinetic and potential energy.

2 **conserve / convert**
   A There isn't much fuel left, so we need to ________________________ it.
   B A dam is used to ________________________ kinetic energy to electrical energy.

5 Listen and read the textbook excerpt again. How is elastic potential energy released?

Listening

6 Listen to a conversation between a student and an instructor. Choose the correct answers.

1 What is the conversation about?
   A the woman's performance on an assignment about energy
   B an oral quiz about different types of potential energy
   C clarification of a lecture on mechanical energy
   D an upcoming exam about energy conversion

2 What is true about thermal energy?
   A It is the result of actively moving particles.
   B It can be converted into other types of energy.
   C It is included when calculating chemical energy.
   D It can be stored and released later.

Speaking

8 With a partner, act out the roles below based on Task 7. Then, switch roles.

**USE LANGUAGE SUCH AS:**

I don't think I understand ... / Think of it like this ...
Does that count ...?

Student A: You are a student. Talk to Student B about:
- an energy concept you do not understand
- an example of that type of energy
- the characteristics of that type of energy

Student B: You are an instructor. Talk to Student A about an energy concept that he or she doesn’t understand.

Writing

9 Use the textbook excerpt and the conversation from Task 8 to write a report on energy. Include: two types of energy, the differences between them, and why they are important in engineering.
ring gear [N-COUNT-U8] A ring gear is a fixed internal gear that encircles a planetary geartrain.

rivet [N-COUNT-U15] A rivet is a permanent metal fastening device that works by deforming and expanding during installation, preventing removal.

robotics [N-UNCOUNT-U11] Robotics is the science of designing and manufacturing robots.

rotational motion [N-UNCOUNT-U6] Rotational motion is the movement of an object in a circle around its center.

RPM [N-COUNT-U6] RPM (revolutions per minute) are the number of complete rotations around an axis that something can complete in one minute.

RPS [N-COUNT-U6] RPS (revolutions per second) are the number of complete rotations around an axis that something can complete in one second.

serial [ADJ-U8] If something is serial, it is part of a series or collection.

serial robot [N-COUNT-U11] A serial robot is a robot that consists of a linear series of parts connected by joints.

shell [N-COUNT-U12] A shell is a strong, curved element that is used in construction.

shift fork [N-COUNT-U7] A shift fork is a mechanism that slides a gear along a splined shaft.

simple geartrain [N-COUNT-U8] A simple geartrain is a chain of three or more gears in which each shaft bears only one gear.

slip [V-I-U7] To slip is to move accidentally from a location.

spark plug [N-COUNT-U3] A spark plug is a device that creates an electrical spark to ignite fuel.

specific heat [N-UNCOUNT-U2] Specific heat is the amount of heat required to raise the temperature of a particular material.

speed [N-UNCOUNT-U7] Speed is the rate at which something moves.

spider [N-COUNT-U8] A spider is a carrier that is specially designed to accommodate multiple planet gears.

stress test [N-COUNT-U14] A stress test is a destructive test that determines a material's strength under different types of stress.

stress-strain curve [N-COUNT-U14] A stress-strain curve is the relationship between the amount of force applied to a material and its corresponding deformation.

structural analysis [N-UNCOUNT-U12] Structural analysis is the study and assessment of structures and their ability to bear loads.

structural load [N-COUNT-U12] A structural load is the amount of weight or pressure that a structure supports.

sump [N-COUNT-U3] A sump is a reservoir that collects oil at the bottom of an engine.

sun gear [N-COUNT-U8] A sun gear is a stationary central gear in a planetary geartrain that transfers rotation to the rest of the machine.

support [V-T-U12] To support something is to bear its weight or prevent it from collapsing.

systems engineering [N-UNCOUNT-U10] Systems engineering is an area of product lifecycle management that focuses on meeting consumer needs and requirements and coordinating relevant disciplines in a project.

technical drawing [N-COUNT-U9] A technical drawing is a precise, realistic drawing of something.

thermal conductivity [N-UNCOUNT-U2] Thermal conductivity is the relative ability of a material to transfer heat.

thermal energy [N-UNCOUNT-U1] Thermal energy is energy that is released by the movement or vibration of a material's atoms or molecules.

thermal shock [N-UNCOUNT-U13] Thermal shock is a common cause of material failure that occurs when an object is subjected to sudden changes in temperature.

thermodynamics [N-UNCOUNT-U2] Thermodynamics is the science of heat energy and its application for performing work.
Career Paths: Mechanical Engineering is a new educational resource for mechanical engineering professionals who want to improve their English communication in a work environment. Incorporating career-specific vocabulary and contexts, each unit offers step-by-step instruction that immerses students in the four key language components: reading, listening, speaking, and writing. Career Paths: Mechanical Engineering addresses topics including materials, simple machines, measurements, basic physics, and career options.

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