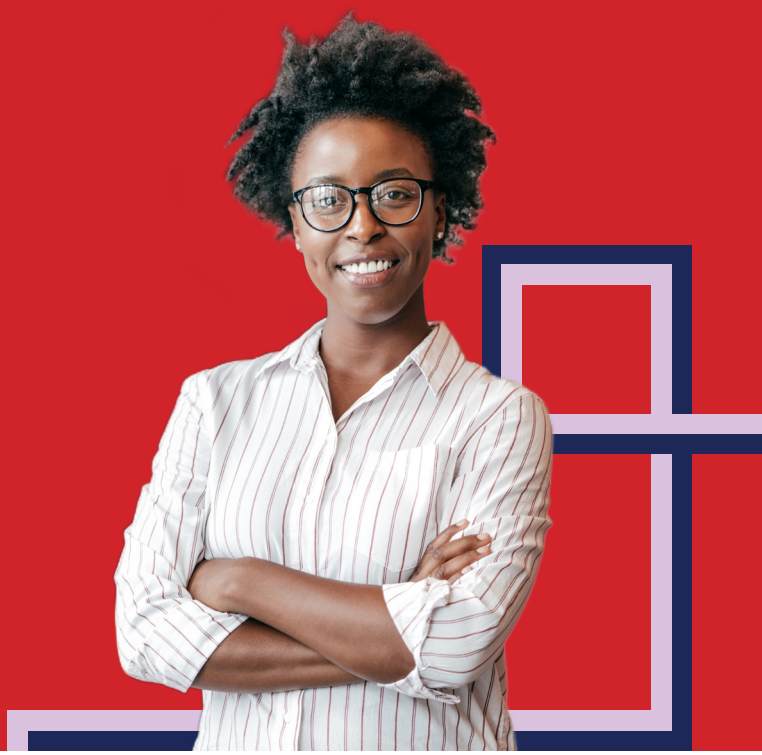
# Engineering: Application-Based Activities

Included in McGraw Hill Connect



## Gauge Student Knowledge in Real-World Scenarios

Prepare students for the real world with Application-Based Activities (ABA) in Connect. These highly interactive, assignable exercises boost engagement and provide a safe space to apply concepts learned to real-world, course-specific problems. Each ABA involves the application of multiple concepts, providing the ability to synthesize information and use critical-thinking skills to solve realistic scenarios.

## Why ABAs?

- Automatic grading syncs with Connect gradebook
- Data-informed decision-making scenarios that allow for multiple outcomes
- Highly interactive, game-like interface
- Students practice problem-solving skills in real-world scenarios
- Reinforces key course learning objectives
- Continued software development to support all learners

## Easy to access in Connect

1. Log in to your Connect Course
2. Click "Add Assignment"
3. Select Application-Based Activity
4. Choose to Assign or Preview the chosen ABA

**Smarter Software. Bigger Breakthoughs.** To learn more, visit mheducation.com/highered/connect »

## Featured Titles

**Statics & Dynamics | Statics & Mechanics of Materials**

**Beer, Vector Mechanics: Statics & Dynamics**

**Plesha, Engineering Mechanics: Statics & Dynamics**

**Beer, Statics & Mechanics of Materials**

## Statics ABA Case Studies

**Air Canada Flight 143**
We will explore the Air Canada Flight 143 incident while gaining a better understanding of SI and US customary units.

**Airport Conveyor**
This assignment will help you understand which strategies to choose when solving statics problems involving friction.

**Burj Khalifa Construction (Moment of Inertia)**
This assignment will help you understand how to determine the area moment of inertia for various cross-sections.

**Dachstein Skywalk**
We will take our knowledge of the equilibrium of a rigid body and apply it to a real-world situation: The Dachstein Skywalk.

**Design of Fort Atkinson Bridge**
This assignment will help you understand the decisions involved during the design and construction of structures to solve real-world practical problems using engineering solutions.

**F15 Strike Eagle**
We will use our knowledge of equivalent systems of forces and apply them to a real-world example of forces acting on this fighter jet in various situations.

**Galveston Seawall**
This assignment will help you understand which strategies to choose when solving static problems involving distributed forces such as forces on submerged surfaces.

**Offshore Wind Turbine Loading**
Shear and bending moment diagrams - This assignment will help you understand axial, shear, and bending moments in a member.

**Pinecone Drop**
We will explore a particle in equilibrium while looking at the forces developed while the pinecone hangs in equilibrium.

**Skid Steer (Machine Analysis)**
This assignment will help you understand which strategies to choose when solving statics problems involving machines.

## Statics ABA Skills Problems

Students will review problems on the following topics in an interactive application format.

- Centroids
- Distributed Loads
- Frames
- Internal Force Equilibrium
- Introduction to Force Vector Diagrams
- Introduction to Moments
- Moment of Inertia
- Three Dimensional Unit Vectors
- Two Dimensional Particle Equilibrium Systems
- Two Dimensional Rigid Body Equilibrium

## Dynamics ABA Case Studies

**The Catapult Defense**
In this case study, you must operate a catapult capable of throwing stones at any pirate ship that approaches the harbor.

**Cannon Recoil (Plane Motion of Rigid Bodies: Energy & Momentum Methods)**
In this case study, you will investigate the effect of firing high-power artillery shells from a light, nimble warship.

**Car off a Cliff**
In this case study you will explore a system that only contains kinetic and gravitational potential energy while assessing what if any outside forces might be acting on the system to produce a known outcome. You will learn to reconstruct starting conditions by analyzing how energy is converted throughout the system.

**Curling**
The goal of this assignment is to help you understand which strategies to choose when solving dynamics problems involving particles and kinetic friction.

**NASA's Robotic Space Probe**
This assignment will help you understand which strategies to choose when solving dynamics problems involving rigid bodies in three-dimensional motion.

**Plane in a Crosswind**
You will look at a purely kinematics problem in which you will see how knowledge of basic relative motion can help the pilots of a passenger jet make vital decisions.

**Realistic Snowboarding**
In this case study, we will explore how varying angles of a ski slope will allow the snowboarder to reach different speeds and how the presence of friction forces affects the final velocity.

**Thruster Firing (Plane Motion of Rigid Bodies Force and Acceleration)**
The goal of this assignment is to help you understand which strategies to choose when solving dynamics problems involving linear and rotational acceleration and deceleration forces.

**Trapeze Artist (Plane Motion of Rigid Bodies Energy and Momentum)**
The goal of this assignment is to help you understand which strategies to choose when solving dynamics problems involving objects moving in planar motion utilizing energy and momentum methods.

**Winning the Aquathlon Olympics**
In this activity, we will showcase how we can use our understanding of kinematics to help an athlete improve their performance in an Olympic race.

## Dynamics ABA Skill Problems

Students will review problems on the following topics in an interactive application format.

- Particle Kinematics
- Particle Kinetics
- Rigid Body Kinematics
- Work and Energy

## Featured Titles

### Cengel Fluid Mechanics

### White Fluid Mechanics

### Cengel Fund Thermal Fluid Sciences*

**Conservation of Mass: Density Changes**
In this activity students practice choosing a control volume and applying conservation of mass for a system that involves mixing.

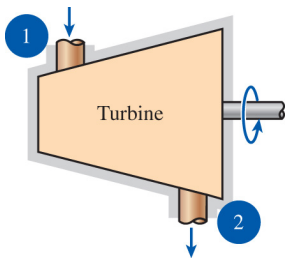
**Pressure Distribution Tank**
This activity helps with bridging the conceptual pressure distribution to the graphical approach.

**Static Pressure and Static Fluids**
The objective of this problem, is to evaluate -the understanding of the differences between static and total pressure (due to flow and evaluation). -the understanding of pressure variation in manometers.

### Cengel Thermodynamics

**Closed System Energy Balance**
Using energy balances to determine the work, heat transfer, and final properties in a closed system.

**Diesel Cycle**
Analyze an ideal Diesel engine cycle, culminating in finding the thermal efficiency of the cycle.



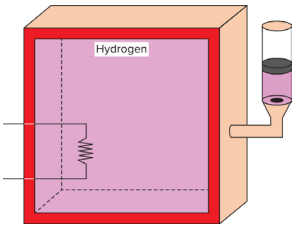

**Entropy Change of Ideal Gas**
Find the exit temperature for an air turbine if air is treated as an ideal gas.

**Entropy Generation**
Calculate the entropy generated when the air in a car tire heats up.

**Investigation of Phase Changes in Water**
In this activity, the user evaluates a boiler tank for safety. Using thermodynamics of a closed system, the pressure and weight of the tank are calculated. The working fluid is water.

**Otto Cycle**
Let's perform an ideal Otto Cycle engine analysis as part of a class project. Find the actual power output for a given gasoline engine.

**Rankine Cycle**
Analysis of a standard Rankine cycle with steam as the working fluid.




**Specific Heats of Ideal Gases**
Utilize your knowledge of specific heats and ideal gases to develop a plan for a heat treat furnace using hydrogen gas as its inert atmosphere.

**Steady-State Analysis of a Heat Exchanger**
Solve for the amount of heat transferred from one medium to another in a steady-state heat exchanger

***Cengel Fund Thermal Fluid Sciences includes all 10 of the Featured Titles above.**

## Featured Title

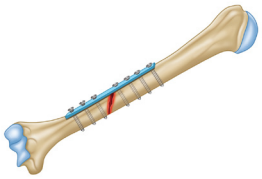
### Smith, Hashemi, Foundations of Materials Science and Engineering

**Case Hardening of Steel Gear**

In this case study, we will try to eliminate the problem of wear of the gear tooth. We will use the principle of diffusion to make the surface of the gear more resistant to wear. This procedure is called case hardening.

**Choosing Bicycle Frame Material**

In this case study, we will discuss how different materials selected for a bicycle frame results in different performance, cost, and safety features. The bicycle frame material is chosen based on the desired features and cost.

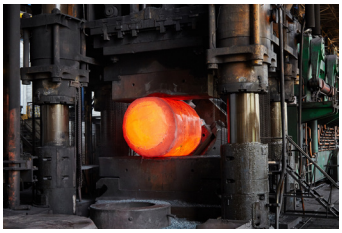


**Forensic Analysis of Failed Orthopedic Screws**

In this case study, we will try to analyze the reasons for fracture of stainless steel screws that secured the dynamic compression plate to the bone.

**Identifying an Unknown Metal**

In this case study, we will try to identify a piece of an unknown material using our knowledge of crystal planes and x-ray refraction data along with basic physical characteristics of the metal.



**Identifying Root Cause for Cracks in Ingots**

In this case study, we will try to identify root cause for cracks developed in steel ingots during normalizing after forging, using advanced optical techniques.

## Featured Titles

**BEST Collection for Introduction to Engineering**

**Eide, Foundations of Engineering**

**Holtzapple, Fundamentals of Engineering and Problem Solving**

**Finkelstein, Technical Writing for Engineers & Scientists**

With the new Application-Based Activities for Introduction to Engineering in McGraw Hill Connect, you can assign interactive problems that tie the material students learn in class to real-world situations. Activities available for this course include:

| | | |
|---|---|---|
| Evaluating Online Sources | Public Speaking Skills: Introductions and Conclusions | Moment of Inertia |
| Reading Critically to Determine the Accuracy of a Text | Public Speaking Skills: Outline Preparation | Equilibrium of Two Dimensional Friction Systems |
| Planning an Argument | Public Speaking Skills: Language and Delivery | Statics Case Study: Air Canada Flight 143 |
| Planning an Analysis | Public Speaking Skills: Visual Aids | Statics Case Study: Pinecone Drop |
| Outlining an Argument | Revising Cover Letters | Statics Case Study: F15 Strike Eagle |
| Outlining a Narration | Introduction to Free Body Diagrams | Statics Case Study: Dachstein Skywalk |
| Public Speaking Skills: Source Evaluation | Two Dimensional Rigid Body Systems | Statics Case Study: Galveston Seawall |
| Public Speaking Skills: Plagiarism and Citations | Two Dimensional Rigid Body Equilibrium | Statics Case Study: Design of Fort Atkinson Bridge |
| Public Speaking Skills: Speaking with Confidence | Introduction to Moments | Statics Case Study: Offshore Wind Turbine Loading–Shear and Bending Moment Diagrams |
| Public Speaking Skills: Ethical Speaking | Centroids | Statics Case Study: Airport Conveyor |
| Public Speaking Skills: Listening | Three Dimensional Unit Vectors | Statics Case Study: Moment of Inertia |
| Public Speaking Skills: Supporting Materials | Truss-Frames | Statics Case Study: Skid Steer (Machine Analysis) |
| Public Speaking Skills: Speech Organization | Internal Force Equilibrium | Group Work and Managing Conflict |

## Application-Based Activities for Engineering Technologies / Trade & Tech

### Petruzella Electricity for the Trades

**Fundamentals, DC and AC Circuits**
In this activity you will: Identify the factors that determine the severity of an electric shock, compare the electrical properties of conductors, insulators, and semiconductors, and recognize the difference between direct current (DC) and alternating current (AC) electricity.

**Electrical Quantities and Ohm's Law**
In this activity you will: Define electric current, voltage, resistance, power, and energy, and list the unit of measurement of each, and c alculate different electric values using Ohm's law

**Operation of Series and Parallel Connected Loads and Control Devices**
In this activity you will: Explain the operation of series connected loads and control devices, and explain the operation of parallel connected loads and control devices.

**Measuring Voltage, Current and Resistance**
In this activity you will: Know the correct units for measuring voltage, current and resistance, and know how to properly use a multimeter to measure voltage, current and resistance

**Ohm's Law and Power Formula**
In this activity you will: use Ohm's law to solve for unknown quantities of current, resistance, or voltage of a simple circuit, and apply the power formula to calculate circuit values in a simple circuit.

**Resistors**
In this activity you will: Calculate the resistance of different resistor configurations, and Illustrate how resistors are used as voltage and current dividers.

**Circuit Values, How Relays Operate and Electric Power Formula**
In this activity you will: Calculate circuit values for a transformer, explain how relays operate, and perform calculations using the electric power formula.

**DC Series Circuit**
In this activity you will: Understand the voltage, current, resistance, and power characteristics of a DC series circuit, Solve for unknown circuit values in a DC series circuit, Apply the concepts of relative polarity, series-aiding, and series-opposing voltages, and Troubleshoot a series DC resistive circuit.

**DC Parallel Circuit**
In this activity you will: Understand the voltage, current, resistance, and power characteristics of DC parallel circuit, Solve for unknown circuit values in a DC parallel circuit, and Troubleshoot a parallel DC resistive circuit.

**DC Series-Parallel Circuit**
In this activity you will: Understand and correctly apply Kirchhoff's voltage and current laws to series-parallel circuits, Solve a DC series-parallel circuit for unknown circuit values, and Understand the operating principles of a three-wire circuit.

**Superposition, Thevenin and Norton Theorems to a DC Resistive Network**
In this activity you will: Apply the superposition theorem to a DC resistive network, and Apply the Thevenin and Norton theorems to a DC resistive network.

**Sine Wave and Line and Phase Currents of Three Phase Circuits, and Voltage, Current Resistance and Power for AC Resistive Circuits**
In this activity you will: Calculate peak and average value of a sine wave and line and phase currents of three phase circuits, and Perform circuit calculations of voltage, current resistance and power for AC resistive circuits.

**Inductance and Capacitance**
In this activity you will: Calculate inductive and capacitive reactance and related time constants, Calculate values for inductive and capacitive circuits, and Explain the effects of inductance and capacitance in DC and AC circuits.

**Vector Quantities; RL, RC, LC & RLC Circuits**
In this activity you will: Plot and interpret vector quantities, and Solve for unknown quantities in series RL, RC, LC, and RLC circuits.

**Parallel Circuits**
In this activity you will: Solve for unknown quantities in a parallel RL, RC, LC, and RLC circuit, and Understand the relationship between true power, reactive power, apparent power, and power factor in a parallel RLC circuit.

**Transformers**
In this activity you will: Calculate transformer turns ratio, voltage, current, and power, and Calculate circuit values for three phase transformers and additive and subtractive polarity.

**Conductors; Fuses & Circuits; Relay Circuits Shorts & Opens**
In this activity you will: Calculate line-voltage drop and line-power loss in conductors, explain the operation of fuses and circuit breakers, and diagnose (troubleshoot) shorts and opens in relay circuits.

**Lighting Circuits and Motor Circuits**
In this activity you will: Explain the operation of a single-pole lamp switch and a three-way lamp switching circuit, and explain the operation of two-wire and three-wire motor starting circuits.

**Electronic Controls**
In this activity you will: Understand the principle of operation of semiconductor devices, Explain the use of semiconductor devices in circuits, and explain the use of logic in control circuits.

## Petruzella, Programmable Logic Controllers

**PLC Communications Troubleshooting**
In this activity you will play: the role of the Electro-Mechanical Maintenance Technician (EMMT) within your company. The scenario is that a PLC has lost all communications with the Human Machine Interface (HMI), Historian (data storage center) and local computer. This has led to the operator not being able to control the machine, view data on the HMI, log data into the company Historian, nor able to “ping” the local computer.

**PLC Data Architecture**
In this activity you will play: the role of the PLC Programmer. The scenario is that the customer of a machine you developed is experiencing issues after a period of run time. A value displayed on the screen is displaying a very large value and then faults the machine out.

**PLC Hardware**
In this activity you will: play the role of the electrical controls engineer. The scenario is that the maintenance technician on duty calls you to the production line to troubleshoot “programming issues” because the machine is “acting up”.

**PLC Programming Methodology and the Importance of Scan Time**
In this activity you will: play the role of the PLC Programmer. The scenario is that the customer of a machine you developed is experiencing issues with erratic movement in a motor on your assembly line.

**PLC System Integration**
In this activity you will: play the role of the Field Service Engineer for The Controls Company. The scenario is that you are onsite and have issues upon startup of a new machine. You are working over the phone with an electrical engineer back at your main facility to troubleshoot the issues.

## Petruzella, Electric Motors & Controls

The application-based activities for Petruzella's Electic Motors and Control Systems are interactive videos that help a student visually understand various learning objectives covered in Chapters 2 – 10. These videos include auto-graded questions to test the students comprehension and offer a more interactive assessment option for your course assignments.

Two-Wire and Three- Wire Control System (Ch. 2)

Transformer Values and Principles of Grounding a Control Transformer (Ch. 3)

Switches and Actuators (Ch. 4)

DC Motor Control Circuits and Three-Phase Reverse Motor Control Circuits (Ch. 5)

Heating and Lighting Contactors, Operation of a SCR, Overload Relays, IEC Symbols (Ch. 6)

Relay Control Systems, Timer Relays, Latching Relays, Logic Circuits (Ch. 7)

Motor Control Circuits (Ch. 8)

Diodes, Transistors, Thyristors, Op Amps and Logic Circuits (Ch. 9)

PLC Motor Starter Circuits, PLC Timers, PLC Counters (Ch. 10)

**To learn more, visit**
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