

# Day 1: 1.1 – The Work of Engineers

## Objectives

Students will:

- Answer the Focus Question: What is the scientific method and how do scientists use it?
- Understand that many different people are involved in designing a new product
- Understand the work of scientists and how it relates to engineering
- Describe the steps of the scientific method
- Define: **scientist, scientific method, experiment, control group, variable**

## Materials

- *Introduction to Engineering Design* Student Manual pp. 000–000, Instructor Manual pp. 1–7, and PowerPoint Slides
- Engineer’s Notebook (optional; student- or instructor-provided foldable booklet or section of notebook reserved for notes, calculations, and other module work)

## Instructional Strategies

**Teacher Tips:** Prior to class, make sure you have read the Introduction and The Role of Scientists in Engineering from Unit 1, Section 1.

**Focus:** Have a volunteer read aloud the Focus Question, and ask students to share what they know about the topic.

**Work for One:** Have students read the Introduction and The Role of Scientists in Engineering from Unit 1, Section 1.

**Whole Group Discussion:** After students finish reading, discuss the reading and review the scientific method. Ask them to use what they just read to make educated guesses about what engineers do.

**Wrap-Up:** Ask the Focus Question again. Have students discuss in pairs and share their thoughts.

**TEKS Science:** 6.2A, 6.2B, 6.2C, 6.2D, 6.3A; 7.2A, 7.2B, 7.2C, 7.2D, 7.3A; 8.2A, 8.2B, 8.2C, 8.2D, 8.3A

**TEKS Math:** 6.10A, 6.10D; 7.11A, 7.11B, 7.15A, 7.15B; 8.4, 8.5A

## Day 2: 1.1 – The Work of Engineers

### Objectives

Students will:

- Answer the Focus Question: What are the similarities and differences between engineers and scientists?
- Understand the work of engineers
- Describe the steps of the engineering design process
- Define: **engineer, engineering design process**

### Materials

- *Introduction to Engineering Design* Student Manual pp. 000–000, Instructor Manual pp. 1–7, and PowerPoint Slides
- Engineer’s Notebook

### Instructional Strategies

**Teacher Tips:** Prior to class, make sure you have read The Role of Engineers from Unit 1, Section 1, and familiarize yourself with the engineering design process.

**Focus:** Have a volunteer read aloud the Focus Question, and have volunteers share the words or ideas that come to mind when they hear the term *engineer*. Note their ideas on the board.

**Work for One:** Have students read The Role of Engineers.

**Whole Group Discussion:** Discuss in detail the steps of the engineering design process, taking care to clarify any points of confusion for students. Note the cyclical nature of both the scientific method and the engineering design process.

**Wrap-Up:** Ask the Focus Question again. Have volunteers explain how their ideas on engineering have changed.

**TEKS Science:** 6.4A; 7.4A; 8.5A

**TEKS Math:** 6.11B; 8.14B

## Day 3: 1.1 – The Work of Engineers

### Objectives

Students will:

- Answer the Focus Question: How can the engineering design process be used to solve a problem?
- Understand the work of engineers
- Describe the steps of the engineering design process
- Define: **engineer, engineering design process**

### Materials

- *Introduction to Engineering Design* Student Manual pp. 000–000, Instructor Manual pp. 1–7, and PowerPoint Slides
- Engineer’s Notebook
- Large paper and markers OR transparencies and pens

### Instructional Strategies

**Teacher Tips:** Prior to class, make sure you have reviewed Example 1.1: Developing Laptop Computers and Exercise 1.1. Make sure to gather markers and paper, or transparencies and pens, for students to use in group work.

**Focus:** Restate the definition of *engineer*. Ask students to describe how the job of engineer and the engineering design process revolve around problem solving.

**Guided Exploration:** Review the engineering design process and Example 1.2.

**Small Group Discussion:** Split students into small groups. Provide students with large sheets of paper and markers, or overhead transparencies and pens. Choose or ask groups to choose two products they use daily, and have groups consider the design constraints engineers had to consider when designing these products. Ask them how scientists could have contributed. Have students write their answers on the paper/transparency so they can share ideas with other groups.

**Whole Group Discussion:** Have students present their answers. Then, ask them to describe the advantage of working in groups on engineering projects. Guide students to see that working in groups allows engineers to look at all aspects of a project from many different angles. Engineers can then explore many different possible designs and identify/correct design flaws.

**Wrap-Up:** Have students brainstorm problems that the engineering design process could resolve.

**TEKS Science:** 6.4A; 7.4A; 8.5A

## Day 4: 1.1 – The Work of Engineers

### Objectives

Students will:

- Answer the Focus Question: How can you use the scientific method to build the safest wheelchair ramp?
- Develop a working definition of *safe*
- Design a method and collect data to determine the safest type of ramp using their definition
- Define: **data, safe**

### Materials

- *Introduction to Engineering Design* Student Manual pp. 000–000, Instructor Manual pp. 1–7, and PowerPoint Slides
- Engineer’s Notebook
- Activity 1.2: Wheelchair Ramp Safety
- Materials: sets of painted and unpainted ramps, toy cars, marbles, blocks, rubber pieces that fit the ramps’ surfaces, tape, metersticks or rulers, stopwatches, water bottles

### Instructional Strategies

**Teacher Tips:** Prior to class, make sure you have read Activity 1.2: Wheelchair Ramp Safety and assembled the necessary materials.

**Focus:** Have a volunteer read aloud the Focus Question, and ask students to discuss in small groups how the scientific method could possibly relate to wheelchair ramp safety.

**Guided Exploration:** Have volunteers read aloud Activity 1.2, Objective, Materials, Background, and Procedure. Review the main goal of the activity. Remind students to keep the steps of the scientific method in mind as they work. You may also want to show them how to use some of the equipment (e.g., stopwatches).

**Small Group Discussion:** Put students in groups and allow them time to brainstorm ways to measure ramp safety. Make all materials available to students so they can visualize and manipulate them to design their experiments. Have students complete Experimental Design, question 2 once they have their experiment designed.

**Wrap-Up:** Remind students that they will build and test their ramps tomorrow. Allow time for students to ask any final questions about their designs.

**TEKS Science:** 6.2A, 6.2B, 6.2C, 6.2D, 6.2E, 6.3A, 6.4A; 7.2A, 7.2B, 7.2C, 7.2D, 7.2E, 7.3A, 7.4A; 8.2A, 8.2B, 8.2C, 8.2D, 8.2E, 8.3A, 8.4A

**TEKS Math:** 6.8C

## Day 5: 1.1 – The Work of Engineers

### Objectives

Students will:

- Answer the Focus Question: How can you use the scientific method to build the safest wheelchair ramp?
- Develop a working definition of *safe*
- Design a method and collect data to determine the safest type of ramp using their definition
- Define: **safe**

### Materials

- *Introduction to Engineering Design* Student Manual pp. 000–000, Instructor Manual pp. 1–7, and PowerPoint Slides
- Engineer’s Notebook
- Activity 1.2: Wheelchair Ramp Safety
- Materials: sets of painted and unpainted ramps, toy cars, marbles, blocks, rubber pieces that fit the ramps’ surfaces, tape, metersticks or rulers, stopwatches, water bottles

### Instructional Strategies

**Teacher Tips:** Prior to class, make sure you have assembled the necessary materials for students to build their ramps, and ascertained whether the classroom will provide enough space for the tests. If students are confused about graphing data and where to place each variable, review with them the DRY MIX acronym: depending, responding, y-axis; manipulated, independent, x-axis.

**Focus:** Have students review the Focus Question and their ramp designs before proceeding to the lab.

**Lab Time:** Allow students time to complete Activity 1.2, Experimental Design, questions 2 and 3. Once each group is finished, provide students with all the materials and allow them to set up their experiments and collect data. Students will probably need room to spread out, so move desks or allow them to work in the hallways if possible. Remind students to record all of their data accurately as they proceed.

**Wrap-Up:** Have students spend a few minutes reviewing their data and explaining in short sentences or phrases why their initial design or modified design worked.

**TEKS Science:** 6.2A, 6.2B, 6.2C, 6.2D, 6.2E, 6.3A, 6.4A;

7.2A, 7.2B, 7.2C, 7.2D, 7.2E, 7.3A, 7.4A;

8.2A, 8.2B, 8.2C, 8.2D, 8.2E, 8.3A, 8.4A

## Day 6: 1.1 – The Work of Engineers

### Objectives

Students will:

- Answer the Focus Question: What is the safest wheelchair ramp design based on your data?
- Write a business letter to the principal to recommend the type of ramp he should build
- Define: **safe, business letter**

### Materials

- *Introduction to Engineering Design* Student Manual pp. 000–000, Instructor Manual pp. 1–7, and PowerPoint Slides
- Engineer’s Notebook
- Activity 1.2: Wheelchair Ramp Safety
- Sample business letters using different formats
- Computers with word processing programs

### Instructional Strategies

**Teacher Tips:** Prior to class, assemble a few examples of properly formatted, well-written business letters. Be prepared to teach students about business letters, if needed. Note that students will also need access to computers with word processing programs, though they may handwrite their letters neatly if computers are not available.

**Focus:** Have students read the Focus Question and discuss the answer in their lab groups, using their data.

**Guided Exploration:** Review or teach students how to write business letters. Show them several samples that use different formats. Review the requirements listed in Activity 1.2, Assessment, including the grading rubric.

**Small Group Work:** Have students write their business letters (only one letter required per group). When they have finished, have groups peer edit each other’s letters and then make corrections.

**Wrap-Up:** Have groups volunteer to share their letters with the class.

**TEKS  
Science:** 6.2A,  
6.2B,  
6.2C,  
6.2D,  
6.2E,  
6.3A,  
6.4A;

7.2A,  
7.2B,  
7.2C,  
7.2D,  
7.2E,  
7.3A,  
7.4A;

8.2A,  
8.2B,  
8.2C,  
8.2D,  
8.2E,  
8.3A,

8.4A

## Day 7: 1.1 – The Work of Engineers

### Objectives

Students will:

- Answer the Focus Question: Which bungee cord design will carry an egg through a drop and rebound without cracking it?
- Use the engineering design process to develop a bungee cord that will carry a raw egg to 5 cm above the floor and rebound 15 cm

### Materials

- *Introduction to Engineering Design* Student Manual pp. 000–000, Instructor Manual pp. 1–7, and PowerPoint Slides
- Engineer’s Notebook
- Activity 1.3: Don’t Scramble the Eggs!
- Materials: nylon stockings, rubber bands, balloons, string, tape, glue, paper clips, staples, hole punch, metersticks or tape measures, raw eggs, floor coverings, paper towels

### Instructional Strategies

**Teacher Tips:** Prior to class, make sure you have read Activity 1.3: Don’t Scramble the Eggs and assembled the necessary materials.

**Focus:** Have a volunteer read aloud the Focus Question, and explain that they will carry out a lab activity over the next two days that will help them answer this question.

**Guided Exploration:** Have volunteers read aloud Activity 1.3 parts Objective, Materials, and Procedure. Review the main goal of the activity. Review the goal of the lab with students, as well as the rubric. Emphasize the importance of taking notes and making drawings. Draw their attention to Data, where they will record their results.

**Lab Time:** Split students into groups and allow them time to brainstorm possible ideas. Provide students with all of the materials listed so they can visualize and manipulate them. Encourage students to study unsuccessful designs to determine how they might have failed, and to use this information to modify the designs. After they have decided on a design, allow them to build and test their bungee cords. Carefully supervise students around drop areas.

**Wrap-Up:** Allow students to clean up any broken eggs and failed bungee cords, and to discuss any final preparations they must make for the egg-jump competition.

**TEKS Science:** 6.3B, 6.3C, 6.4A; 7.3A, 7.3B, 7.4A; 8.4A, 8.5A, 8.5B, 8.5C

## Day 8: 1.1 – The Work of Engineers

### Objectives

Students will:

- Answer the Focus Questions: What modifications did you make to your initial design? Were the modifications helpful?
- Use the engineering design process to develop a bungee cord that will carry a raw egg to 5 cm above the floor and rebound 15 cm
- Define: **modifications**

### Materials

- *Introduction to Engineering Design* Student Manual pp. 000–000, Instructor Manual pp. 1–7, and PowerPoint Slides
- Engineer’s Notebook
- Activity 1.3: Don’t Scramble the Eggs! handout
- Materials: nylon stockings, rubber bands, balloons, string, tape, glue, paper clips, staples, hole punch, metersticks or tape measures, raw eggs, floor coverings, paper towels

### Instructional Strategies

**Teacher Tips:** Prior to class, make sure you have enough supplies on hand for the egg-drop competition and for students who may make last-minute adjustments to their designs.

**Focus:** Have a volunteer read aloud the Focus Question, and remind them that modifications are an expected part of the engineering design process, not failures.

**Lab Time:** Allow students some time to finish testing their bungee cords and modifying the designs based on results. Then, gather students in a circle so they can see the egg-drop competition. Drop each group’s bungee cord/egg individually and measure the drop and retraction heights.

**Wrap-Up:** Allow students time to complete Analysis.

**TEKS Science:** 6.3B, 6.3C, 6.4A;

7.3A, 7.3B, 7.4A;

8.4A, 8.5A, 8.5B, 8.5C

## Day 9: 1.1 – The Work of Engineers

### Objectives

Students will:

- Answer the Focus Question: Why are engineers and scientists considered interdependent?
- Understand that science and engineering are interdependent
- Define: **interdependence**

### Materials

- *Introduction to Engineering Design* Student Manual pp. 000–000, Instructor Manual pp. 1–7, and PowerPoint Slides
- Engineer’s Notebook

### Instructional Strategies

**Teacher Tips:** Prior to class, make sure you have read *Science and Engineering Are Interdependent* from Unit 1, Section 1.

**Focus:** Ask students to define *interdependent*. Ask students how plants and animals are interdependent and how students and teachers are interdependent. Give them a few minutes to discuss these with a partner.

**Work for One:** Have students read *Science and Engineering Are Interdependent*.

**Whole Group Discussion:** Discuss the concept of interdependence and have volunteers provide other examples. Allow time for students to ask questions about the reading.

**Wrap-Up:** Wrap up the lesson with a discussion of student responses. Have a different member of each group explain his or her group’s response to one of the questions.

**TEKS Science:** 6.4A; 7.4A; 8.5A

# Day 10: 1.2 – Block Diagrams in Engineering Designs

## Objectives

Students will:

- Answer the Focus Question: What is the benefit of drawing block diagrams as part of the engineering design process?
- Understand the purpose of block diagrams in engineering
- Define: **block diagram**

## Materials

- *Introduction to Engineering Design* Student Manual pp. 000–000, Instructor Manual pp. 7–9, and PowerPoint Slides
- Engineer's Notebook
- Exercise 1.4: Block Diagrams in Engineering Design

## Instructional Strategies

**Teacher Tips:** Prior to class, make sure you have read Unit 1, Section 2: Block Diagrams in Engineering Design.

**Focus:** Ask students to take 5 minutes and write everything they know about diagrams in their Engineer's Notebooks.

**Work for One:** Have students read Block Diagrams in Engineering Design.

**Whole Group Discussion:** Use the diagrams from the reading to illustrate that block diagrams can be fairly simple or more complex. Remind students that block diagrams don't always show all the details for each component in a product; they may just summarize how key components fit together.

**Small Group Discussion:** Have students work in groups, and assign Exercise 1.4: Block Diagrams in Engineering Design questions. Consider putting a lamp without its shade on display for question 1 so students can visualize the parts. Also consider showing students a newspaper article or evening news clip about a recalled product for question 2.

**Wrap-Up:** Wrap up the lesson by having students share their block diagrams with another group and discussing responses to question 2.

**TEKS Science:** 6.3C; 7.3C; 8.3C

# Day 11: Unit 2 – Careers in Engineering

## Objectives

Students will:

- Answer the Focus Question: What do the different types of engineers do?
- Understand that there are many different types of engineers
- Understand how to become an engineer
- Take an interest survey to identify an engineering discipline in which they have an interest

## Materials

- *Introduction to Engineering Design* Student Manual pp. 000–000, Instructor Manual pp. 10–12, and PowerPoint Slides
- Engineer’s Notebook
- Exercise 2.1: Careers in Engineering
- Computers with Internet access and word processing or spreadsheet programs

## Instructional Strategies

**Teacher Tips:** Prior to class, make sure you have read Unit 2: Careers in Engineering and arranged for students to use computers, print resources, or media resources for the next three days.

**Focus:** Have students revisit their thoughts on engineering from Day 1. Ask what they expect to learn about in today’s reading.

**Work for One:** Have students read Unit 2. Later in the lesson, have them fill out the interest survey portion of Exercise 2.1: Careers in Engineering independently.

**Whole Group Discussion:** Discuss the reading. Remind students that the reading only lists a few types of engineers. Explain that there are countless engineering disciplines and that many engineers get to do some interesting work. Have students fill out the interest survey. When students have finished, review it as a class, and group students based on their interests.

**Wrap-Up:** Have students meet briefly with their interest groups and brainstorm a list of topics to research and where to find information.

**TEKS Science:** 6.2E, 6.3E; 7.2E, 7.3E; 8.2E, 8.3E

## Day 12: Unit 2 – Careers in Engineering

### Objectives

Students will:

- Answer the Focus Question: How do you become an engineer?
- Research an engineering discipline in which they have an interest

### Materials

- *Introduction to Engineering Design* Student Manual pp. 000–000, Instructor Manual pp. 10–12, and PowerPoint Slides
- Engineer’s Notebook
- Exercise 2.1: Careers in Engineering
- Computers with Internet access and word processing or spreadsheet programs

### Instructional Strategies

**Teacher Tips:** Prior to class, make sure you have read Unit 2: Careers in Engineering and secured resources for students’ use.

**Focus:** Have students review yesterday’s Wrap-Up and Exercise 2.1: Careers in Engineering before beginning their research.

**Small Group Discussion:** Allow students the full class period to research their career interests (as determined by yesterday’s survey) and to put together brief, informal presentations about their chosen careers. Encourage students to be creative; for example, they might role-play a day in the life of their types of engineers.

**Wrap-Up:** Leave time for students to ask any last-minute questions about their presentations.

**TEKS Science:** 6.2E, 6.3E; 7.2E, 7.3E; 8.2E, 8.3E

## Day 13: Unit 2 – Careers in Engineering

### Objectives

Students will:

- Answer the Focus Question: What are some similarities and differences between the different types of engineers?
- Present their research on an engineering discipline in which they have an interest

### Materials

- *Introduction to Engineering Design* Student Manual pp. 000–000, Instructor Manual pp. 10–12, and PowerPoint Slides
- Engineer’s Notebook
- Exercise 2.1: Careers in Engineering

### Instructional Strategies

**Teacher Tips:** Devote the entire class period to presentations.

**Focus:** Remind students that today, they will be listening to presentations about a variety of engineering disciplines. Ask students to jot down notes about disciplines that interested them and any interesting similarities or differences among the disciplines.

**Whole Group Discussion:** Have each group present their research.

**Wrap-Up:** Encourage students to ask any questions they have regarding the presentations.

**TEKS Science:** 6.3D; 7.3D; 8.3D

## Day 14: Unit 2 – Careers in Engineering

### Objectives

Students will:

- Answer the Focus Question: Why are many different types of engineers involved in a single project?
- Understand that different engineers have different areas of expertise
- Understand that different engineers work together on projects and share their expertise
- Define: **expertise, other terms as required by supplemental material**

### Materials

- *Introduction to Engineering Design* Student Manual pp. 000–000, Instructor Manual pp. 10–12, and PowerPoint Slides
- Engineer’s Notebook
- Video of engineers designing and building robots, video games, or roller coasters
- Guest speaker (engineer)

### Instructional Strategies

**Teacher Tips:** Prior to class, secure videos of engineers carrying out high-interest tasks or a guest speaker who works in an engineering field. You might find such a speaker by asking around among colleagues, parents of students, or local businesses. If your school holds Career Days or similar events, use the planning resources to find a contact in engineering.

**Focus:** Have students review the Engineering Design Process diagram on page 000. Ask volunteers to explain why they think this process could involve engineers of different specialties.

**Small Group Discussion:** Show students a video that involves engineering a product of high interest, or invite an engineer to give a presentation about an interesting project. If possible, ask the engineer to bring in prototypes for students to see. Emphasize the fact that different types of engineers collaborate on projects because each engineer has specialized knowledge.

**Wrap-Up:** Provide students with an opportunity to ask questions of the guest speaker or about the video. Remind them to study for tomorrow’s exam.

**TEKS Science:** 6.3D; 7.3D; 8.3D

# Day 15: Module Exam

## Objectives

Students will demonstrate their understanding of the engineering design process by completing the module exam.

## Materials

- Copies of the module exam

## Instructional Strategies

**Assessment:** Hand out the module exam and allow students the full class period to complete it.

**TEKS Science:** 6.2A, 6.2B, 6.2C, 6.2D, 6.3A, 6.3B, 6.3C, 6.3D, 6.3E, 6.4A;

7.2A, 7.2B, 7.2C, 7.2D, 7.3A, 7.3B, 7.3C, 7.3D, 7.3E, 7.4A;

8.2A, 8.2B, 8.2C, 8.2D, 8.3A, 8.3B, 8.3C, 8.3D, 8.3E, 8.5A, 8.5B, 8.5C

**TEKS Math:** 6.8C, 6.10A, 6.10D, 6.11B; 7.11A, 7.11B, 7.15A, 7.15B; 8.4, 8.5A, 8.14B