

**STEM**  
*Careers*

TIME

# Enhancing Engineering

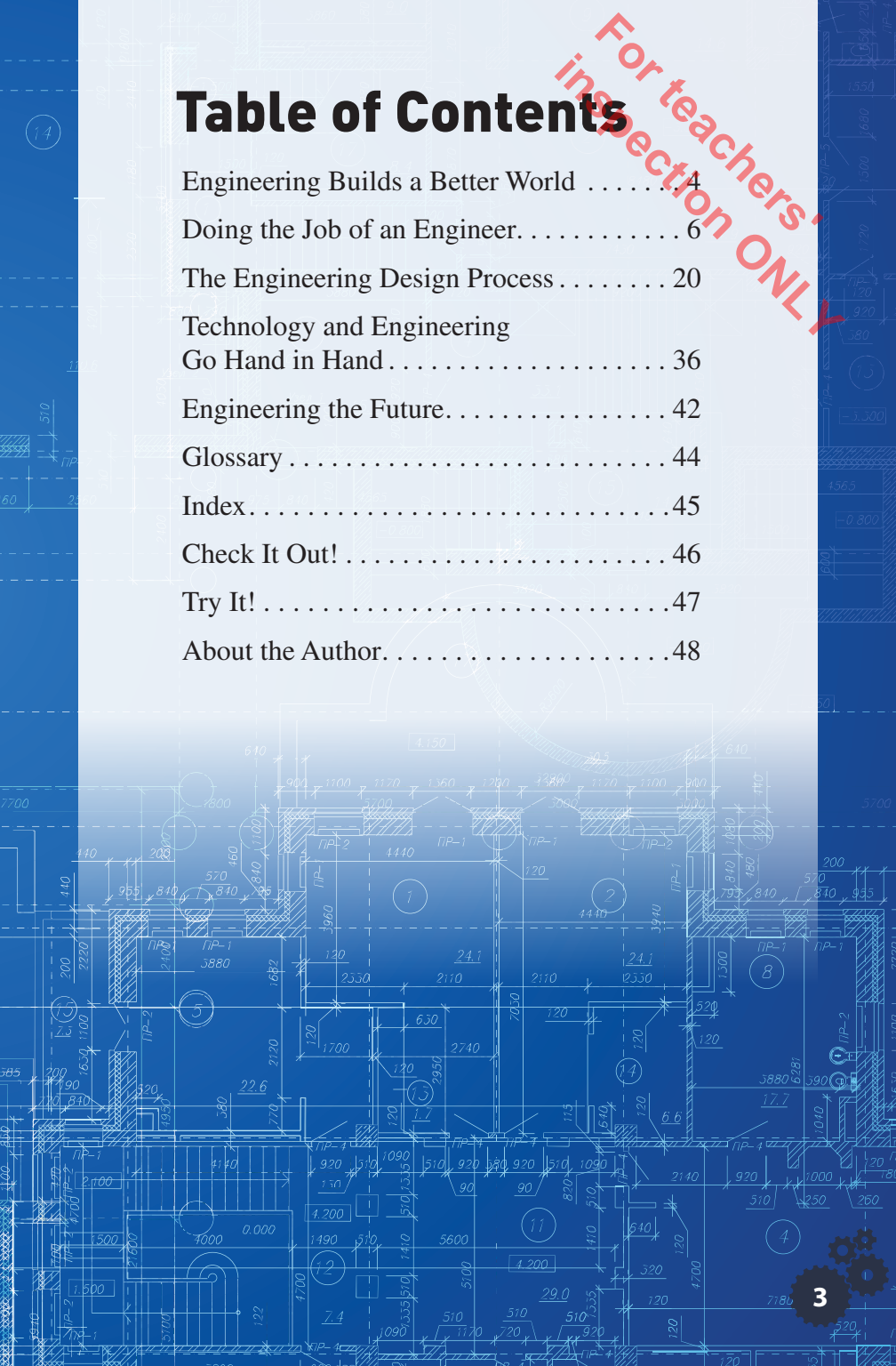


**Wendy Conklin**

# Table of Contents

Engineering Builds a Better World . . . . .	4
Doing the Job of an Engineer. . . . .	6
The Engineering Design Process . . . . .	20
Technology and Engineering Go Hand in Hand . . . . .	36
Engineering the Future. . . . .	42
Glossary . . . . .	44
Index . . . . .	45
Check It Out! . . . . .	46
Try It! . . . . .	47
About the Author. . . . .	48

For teachers' inspection ONLY



# Engineering Builds a Better World

Imagine you owned a robot that could sense a human's mood and emotions. What if someday you lived on the moon—or better yet, Mars? Or, if your favorite pet dies, you have it cloned so that you can have another pet *exactly* like it. If any of this intrigues you, you might want to consider becoming an engineer.

Engineering is the field of technology where people come up with new ideas, build them, and then test their ideas. While an engineer is not strictly a scientist, engineering has a lot to do with science. A scientist observes things and has **theoretical** ideas. Engineers build machines, structures such as bridges or roads, and systems found in video games and smart phones. Engineering is applying science to solve problems in our everyday lives. It's *doing* science, but engineering also involves math, design, psychology, and creativity.

## These Things Are Possible!

With the exception of living on the moon or Mars, the amazing accomplishments included above already exist. There are robots that can tell if you are happy, and there are scientists who clone animals.



For teachers'  
inspection ONLY



**THINK  
LINK**

- © What are some things you use every day that an engineer designed?
- © How have advancing technologies created new jobs or transformed old ones in engineering?
- © How would our lives be different if there were no engineers?



# Doing the Job of an Engineer

Engineers design and build things such as driveways, computer software, and flying suits. But, to say that someone is an engineer doesn't give us a clear idea of what he or she does beyond designing and building. The designing and building process involves steps and takes time.

Engineers affect our everyday lives. For example, think about the features on a smart phone and how these features improve our lives. Engineers came up with these ideas. They built **prototypes** based on their ideas, and then they tested these ideas to see if they worked. Many times, engineers have to “go back to the drawing board” by changing their ideas or completely starting over. It becomes a trial-and-error process.

There are more than 200 different **disciplines** or fields of engineering. These fields are divided into four main branches. The branches are chemical, civil, electrical, and mechanical.



## The Roads Around You

Do you ever see roads under construction? Transportation engineers are involved in this construction. They are the people who plan, design, and upgrade streets and highways.

## Fore!

The game of golf, as we know it today, began in Scotland in the 1450s. Since then, the golf ball has gone through its own evolution. First, it was made with feathers, then rubber. Throughout these changes, the different designs were tested. Balls made with indentations went farther than those without. In 1905, William Taylor, an English engineer, **patented** the dimples that are on golf balls.



For teachers' inspection ONLY

## Disciplines of Engineering

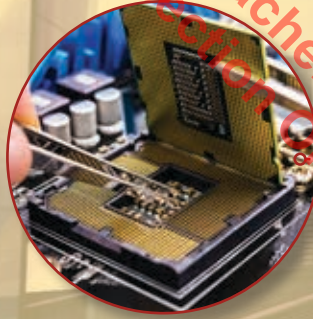
Engineering offers a wide variety of exciting career choices. Here are some specialized disciplines organized under the four main engineering branches:

### • Chemical Engineering

- ceramic engineering
- materials engineering
- paper engineering
- plastics engineering
- petroleum engineering

### • Civil Engineering

- architectural engineering
- construction engineering
- earthquake engineering
- ecological engineering
- environmental engineering
- fire protection engineering
- geotechnical engineering
- highway engineering
- hydraulic engineering
- mining engineering
- railway engineering
- structural engineering
- traffic engineering
- transportation engineering
- water resource engineering



## • Electrical Engineering

- computer engineering
- control engineering
- electronics engineering
- microelectronics engineering
- power engineering
- software engineering
- telecommunications engineering

## • Mechanical Engineering

- acoustic engineering
- aerospace engineering
- audio engineering
- automotive engineering
- manufacturing engineering
- marine engineering
- nuclear engineering
- thermal engineering





# Chemical Engineering

Think about your favorite toys when you were young. With the exception of stuffed animals, the toys were most likely made from plastic. You can thank a chemical engineer for those toys!

Chemical engineers create better plastics, paper, paint, medicine, and fuel. Their jobs include, for example, designing plastic toys that are both safe and fun for children. Have you ever been in a freshly painted room and smelled strong chemicals? Chemical engineers work to create **nontoxic** paint so that people don't get sick from the fumes. They take lumber and bark and turn them into paper products such as notepads and cardboard. These engineers also work to build more fuel-efficient vehicles.

## Snurfin' U.S.A.

In 1965, Sherman Poppen's daughters were fidgety. Being an engineer, he put two skis together and sent his girls outside to try them. After watching them stand on his contraption going downhill, he replaced the skis with one board and attached a rope to the front for steering. His wife combined the words *snow* and *surf* to name the contraption a Snurfer. Many people believe Poppen's invention contributed to the design of snowboards.

**Petroleum** engineering is a type of chemical engineering. These engineers produce fuels for vehicles and machinery. They focus on the processes and equipment used to refine oil into a form that is usable. Petroleum engineers figure out strategies for extracting oil from wells. And they focus on how to drill to get the oil safely.

You will find chemical engineers working with mining, oil companies, **pharmaceutical**, and food production companies.

### **Geology Rocks!**

Petroleum engineers have to know geology to do their jobs safely. They need to know what types of rocks they are drilling into. They also have to know about the **properties** of metal in the bits they use during drilling.

# Civil Engineering

If you like organizing and planning big projects, civil engineering might be great for you. Civil engineers have designed a tunnel that could cross the Bering Strait. The tunnel would span about 60 miles (96.5 kilometers) and connect Russia and Alaska. Other engineers have drafted a plan for Tokyo's Sky City 1000. This high-rise city with apartments, offices, theaters, and schools will house approximately 35,000 people.

Imagine a city within a pyramid! Civil engineers have proposed that, too. It is called the Mega-City Pyramid, and the plans are to build it over Tokyo Bay in Japan. About one million people will be able to live there.

While these projects are in the designing and testing phases, the Burj Al Arab is a reality. It is a luxury hotel in Dubai. It stands 1,050 feet (320 meters) tall, and the hotel's restaurant is suspended 82 feet (25 meters) away from the main building.

Civil engineers figure out how to build these amazing structures and make them safe. They have to understand how weather affects the materials they use. If it rains, will the saturation of water affect the building? If the ground swells, will the structure be compromised? They also must know the chemical properties of the metals they use. **Ferrous metals** like steel are strong but heavy. **Nonferrous metals** are also strong but much lighter.

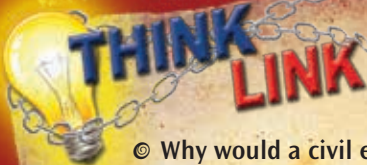




## Lessons Learned from 9/11

After the Twin Towers of the World Trade Center collapsed on September 11, 2001, civil engineers explored more ways to protect people. While no building may be able to withstand a plane's impact, engineers can design shelters within high rises where people can wait out fires or other disasters. They also are designing buildings that won't collapse due to fires.

Burj Al Arab Hotel  
in Dubai



- © Why would a civil engineer need a strong background in math and science when designing a tall building?
- © If a civil engineer makes a mistake on the types of materials used in a building, what might happen?
- © How can civil engineers learn from structures built long ago?



# Glossary

**decision matrix**—a chart that helps team members identify priorities when working on projects

**deliverables**—materials like design boards, drawings, video concepts, and prototypes that engineers give to clients after solving problems

**design brief**—the document that has all the information designers use when solving problems for clients

**disciplines**—fields or areas of engineering

**ferrous metals**—metals that are mostly made of iron

**impurities**—substances that contaminate

**nonferrous metals**—metals that don't contain iron

**nontoxic**—nonpoisonous, safe materials

**patented**—earned the sole rights to an invention

**petroleum**—crude oil found in the earth

**pharmaceutical**—prescription drug

**properties**—qualities, traits, or attributes

**prosthetic**—a man-made device that replaces a missing human body part, such as a limb

**prototypes**—models of designed products

**simulations**—enactments of something meant to be tests

**theoretical**—hypothetical ideas, existing in theory only

**turbines**—engines powered by steam or gas that make large blades turn

For teachers' inspection ONLY

# Try It!

Imagine you are an engineer hired to design a new toy, bridge, roller coaster, or something in your local community.

- ⦿ First, decide what type of engineer you would like to be.
- ⦿ Next, choose what you would like to design for your community.
- ⦿ Follow the steps through the engineering design process on pages 22–23 to guide you.
- ⦿ After all your hard work, share your design presentation with an audience.



For teachers' inspection ONLY

# Reader's Guide

For teachers' inspection ONLY

1. Why are engineers important to our society, both today and long ago?
2. How does the work that engineers do affect people's everyday lives?
3. If you were to go into engineering, what type of engineer do you think you'd become and why?
4. Based on what you know about engineers, what types of things might engineers do in the future?

