

JOBS OF THE FUTURE: ENGINEERING IN ACTION

What do giant 3D printers, brain-controlled robotic hands, and solar windows have in common? They're all made possible by engineering — and they're just the beginning.

This resource gives high school students a chance to explore the bold, creative, and world-changing work that engineers do. It is based on work done by the National Academy of Engineering to identify the "Greatest Engineering Accomplishments of the 20th Century" and "Grand Engineering Challenges of the 21st Century." Through interactive activities, engaging prompts, and real-world examples, students will discover how engineering touches every part of their lives — from the phones in their hands to the clean water in their homes.

The "Jobs of the Future" experience is designed to spark curiosity and connect students' everyday interests with exciting career possibilities. Step by step, they'll learn how engineers solve real problems, tackle the planet's biggest challenges, and invent the future. Along the way, students will imagine their own role in that future — thinking about the skills they have, the issues they care about, and the difference they want to make.

Whether your students dream of exploring space, saving the environment, or designing the next big tech innovation, this guide helps them see that a career in engineering might be the path that makes it all possible.

Let's open their eyes to the power — and possibility — of engineering.

Amazing Engineering

EXERCISE 1.1

True/False Warm-up

LEARNING OUTCOME

Develop a fuller awareness of what engineering can make real.

ACTIVITY

Lead class in True/False exercise made up of attention-getting examples of some amazing things engineers are doing.

INSTRUCTIONS

- Read aloud the statements below and ask the class to answer with either “True” or “False.”
- The answers will all be “True” and the effect should be to expand students’ awareness of what engineering can do and get them interested in learning more about the field.

TRUE/FALSE STATEMENTS

1. A giant robot can 3D-print a full-size house in just ten days — no hammers, no nails.
2. The oil used to cook French fries can now be reused to fuel cars.
3. A robotic hand can learn your brain and muscle signals and get more lifelike the more you wear it.
4. Special concrete can heal its own cracks using bacteria or algae.
5. Some clothes are now being made from mushrooms.
6. A window that looks like normal glass can secretly act like a solar panel.
7. Glasses lighter than a deck of cards can play movies on a 10-foot virtual screen, for your ears and eyes only.
8. NASA and SpaceX are teaming up to fly astronauts to the Moon — and maybe even Mars.
9. Drones are dropping off blood, vaccines — and yes, even hot pizza — faster than traffic can move.
10. Self-driving trucks are learning to drive cross-country with no one behind the wheel.

Amazing Engineering

EXERCISE 1.2

Digging deeper into amazing engineering feats

LEARNING OUTCOMES

- Connect real-life details about engineers' work to amazing engineering feats.
- Engineering starts to seem less like “magic” and more like something real people do in the real world.

ACTIVITY

In groups, students review each True/False item, find the description of it in the What's Engineering section of the Career Guide, and record 3 facts or features about the item mentioned in the text.

INSTRUCTIONS

- Hand out or display on screen Worksheet 1.2 with True/False items and space for students to record 3 facts about each.
- Divide students into small groups and tell them to review the What's Engineering section (pages 2-7) of the Career Guide to locate 3 facts for each item.
- Ask students to reflect on and discuss any responses or observations related to the exercise. Prompt them for anything especially surprising, interesting, or exciting. And ask if they think any differently about engineering as a result of the exercise.

RESOURCES

1. Engineering Career Guide, condensed edition
2. Worksheet 1.2

WORKSHEET 1.2

Review the What's Engineering section (pages 2-7) of the Engineering Career Guide and locate 3 facts for each item below.

1. A giant robot can 3D-print a full-size house in just ten days — no hammers, no nails.

2. The oil used to cook French fries can now be reused to fuel cars.

3. A robotic hand can learn your brain and muscle signals and get more lifelike the more you wear it.

4. Special concrete can heal its own cracks using bacteria or algae.

WORKSHEET 1.2 (CONTINUED)

5. Some clothes are now being made from mushrooms.

6. A window that looks like normal glass can secretly act like a solar panel.

7. Glasses lighter than a deck of cards can play movies on a 10-foot virtual screen, for your ears and eyes only.

8. NASA and SpaceX are teaming up to fly astronauts to the Moon — and maybe even Mars.

WORKSHEET 1.2 (CONTINUED)

9. Drones are dropping off blood, vaccines — and yes, even hot pizza — faster than traffic can move.

10. Self-driving trucks are learning to drive cross-country with no one behind the wheel.

► STEP 2

From Great Accomplishments to Grand Challenges

EXERCISE 2.1.a

How engineering shaped the 20th century

LEARNING OUTCOME

Understand how engineering accomplishments shaped and influenced the world throughout the 20th century.

ACTIVITY

Present and discuss examples of great engineering accomplishments of the 20th century.

INSTRUCTIONS

Review the Great Accomplishments virtual card deck with the class:

- a. Show images one at a time, asking students to identify the engineering accomplishment illustrated by each image.
- b. After students offer answers for each image, flip the “card” to identify the actual engineering accomplishment.

RESOURCE

[Great Accomplishments of the 20th century](#), click to launch virtual card deck.

From Great Accomplishments to Grand Challenges

EXERCISE 2.1.b

Imagining engineering accomplishments of the 21st century

LEARNING OUTCOME

Develop ability to apply nascent understanding of engineering to present-day living conditions.

ACTIVITY

Class discussion about possible engineering accomplishments of the 21st century.

INSTRUCTIONS

- With discussion of 20th-century engineering accomplishments in mind, ask students to brainstorm what the engineering accomplishments of the 21st century might be.
- Identify challenges or problems or things students could imagine working differently in the present day.
- Prompt them to imagine engineering solutions related to these circumstances.
- Record ideas on screen or whiteboard.

From Great Accomplishments to Grand Challenges

EXERCISE 2.1.c

Identifying Grand Challenges of the 21st century

LEARNING OUTCOME

Familiarity with how engineering solutions might help to address current areas of challenge or difficulty for society.

ACTIVITY

Class discussion to identify and discuss current challenges to society and possible engineering solutions for them.

INSTRUCTIONS

- Load Grand Challenges virtual card deck for display on screen.
- Show images of Grand Challenges and ask students to identify and describe what the picture represents as an engineering challenge.
- Reveal the Grand Challenge definition on the “back” of the card.

RESOURCE

[Grand Challenges of the 21st century](#), click to launch virtual card deck.

► STEP 2

From Great Accomplishments to Grand Challenges

EXERCISE 2.2

Engineering match game

LEARNING OUTCOME

Understand amazing engineering feats in relation to larger categories of Grand Challenges.

ACTIVITY

In groups or alone, students return to amazing engineering feats of 1.2 and match them up with one or more of the Grand Challenges discussed in 2.1.b.

INSTRUCTIONS

- Ask students to bring out completed Worksheet 1.2, their list of amazing engineering feats plus 3 associated facts.
- Hand out or display Worksheet 2.2 with a list of Grand Challenges and space below each to record amazing engineering feats from 1.2.
- Ask students to connect each of the 10 amazing engineering feats to one or more of the Grand Challenges and briefly explain their reason for making this connection.
- Review students' match game results as a class, addressing themes such as the impact of engineering on making the world a better place, which of the Grand Challenges students might want to work on themselves, or what rank order in priority they might give each Grand Challenge.

RESOURCE

Worksheet 2.2

WORKSHEET 2.2

Connect each of the 10 amazing engineering feats from worksheet 1.2 to one or more of the Grand Challenges below, and briefly explain your reason for making this connection.

1. Make Solar Energy Economical

2. Provide Energy from Fusion

3. Develop Carbon Sequestration Methods

4. Manage the Nitrogen Cycle

WORKSHEET 2.2 (CONTINUED)

5. Provide Access to Clean Water

6. Restore and Improve Urban Infrastructure

7. Advance Health Informatics

8. Engineer Better Medicines

WORKSHEET 2.2 (CONTINUED)

9. Reverse-Engineer the Brain

10. Prevent Nuclear Terror

11. Secure Cyberspace

12. Enhance Virtual Reality

WORKSHEET 2.2 (CONTINUED)

13. Advance Personalized Learning

14. Engineer the Tools of Scientific Discovery

Engineering Brought to Life

EXERCISE 3.1.a

One wish with a Magic Wand

LEARNING OUTCOME

Personal connection to an engineering challenge.

ACTIVITY

Students identify a Grand Challenge that interests them.

INSTRUCTIONS

Ask students to imagine they have a Magic Wand that allows them to solve one and only one of the 14 Grand Challenges.

- a. Students then individually review the list of Grand Challenges to identify the one they would pick to solve and briefly explain why they picked the one they did.
- b. Students record answer on Worksheet 3.1

RESOURCE

Worksheet 3.1

Engineering Brought to Life

EXERCISE 3.1.b

How one wish of a Magic Wand benefits the world.

LEARNING OUTCOME

Understanding of engineering as delivering concrete, real-world benefits.

ACTIVITY

Students imagine 3 real-world benefits to solving their chosen Grand Challenge. Then some or all students share out their ideas with the class as a whole.

INSTRUCTIONS

On their own or in pairs, ask students to complete Worksheet 3.1 by imagining and then describing in some degree of detail what 3 real-world benefits or impacts would result from solving their chosen Grand Challenge.

- a. With 3 real-world benefits done, ask for volunteers to share out their ideas with the class.
- b. Class discussion can explore how students came to their choices, why and how it matters to them personally or to the world, and other personal considerations or values related to the exercise.

RESOURCE

Worksheet 3.1

WORKSHEET 3.1

Review the list of Grand Challenges to identify the one you would pick to solve and briefly explain why you picked the one you did.

My Grand Challenge to solve is:

Why I chose it:

Provide 3 practical benefits or impacts on the world of solving your chosen Challenge.

Getting up close and personal about engineering

EXERCISE 4.1

A medium dive into engineering

LEARNING OUTCOME

General grasp of engineering as containing diverse fields with varied realms of practice.

ACTIVITY

Present a flavor of the wide range of fields that make up engineering as a whole and generally what kind of activities, skills, and work styles it can entail.

INSTRUCTIONS

Warm up for the exercise by presenting an overview of engineering as a field of activity and describing how engineers go about their work. [Read from “Engineering Overview” on the following page.]

- a. Hand out Worksheet 4.1, with list of engineering disciplines taken from Options, Options section of Career Guide.
- b. Review sequence of engineering discipline thumbnail descriptions in virtual card deck, pausing to let students try to match the engineering disciplines in Worksheet 4.1 with the thumbnail description at hand before revealing the name of the engineering discipline.

► STEP 4

EXERCISE 4.1 continued

RESOURCES

1. [Options, Options](#), click to launch virtual card deck of engineering disciplines.

READ ALOUD:

Engineering Overview

Engineers are problem-solvers who use science, math, and creativity to design and build things that make the world work better — like bridges, apps, machines, and clean energy systems. They work in teams, think critically, and often get to see their ideas come to life. Engineering jobs can be hands-on or computer-based, and they usually involve collaboration, attention to detail, and persistence. If you like figuring out how things work, solving challenges, working in teams, and improving the world around you, engineering could be a great fit.

2. Worksheet 4.1, with list of engineering disciplines taken from [Options, Options](#), and space available for each item that students will use in 4.2 to connect 3 impacts identified in 3.1.b with each engineering discipline to which it might be related.

WORKSHEET 4.1

Listed below are the most common engineering disciplines. What real-world impacts can you connect to each engineering discipline? After you're done, rank the engineering disciplines from the most to the least interesting to you!

Aerospace

Agricultural

Biomedical

keep going ➡

WORKSHEET 4.1 (CONTINUED)

Chemical

Civil

Computer

Electrical

WORKSHEET 4.1 (CONTINUED)

Environmental

Manufacturing

Materials

Mechanical

WORKSHEET 4.1 (CONTINUED)

Mining

Nuclear

Ocean

Systems

WORKSHEET 4.1 (CONTINUED)

Now, rank the engineering disciplines from the most to the least interesting to you!

Aerospace _____

Agricultural _____

Biomedical _____

Chemical _____

Civil _____

Computer _____

Electrical _____

Environmental _____

Manufacturing _____

Materials _____

Mechanical _____

Mining _____

Nuclear _____

Ocean _____

Systems _____

Getting up close and personal about engineering

EXERCISE 4.2

Connecting Grand Challenge benefits to engineering disciplines

LEARNING OUTCOMES

- Grasp of how real-world impacts of engineering relate to specific engineering disciplines.
- Understanding of personal affinity for particular engineering disciplines.

ACTIVITY

Students connect imagined impacts of solving a Grand Challenge to specific engineering discipline.

INSTRUCTIONS

Ask students to go back to Worksheet 3.1 and review the 3 real-world impacts they imagined resulting from solving one of the Grand Challenges.

- Applying their understanding of specific engineering disciplines, ask students to identify which of them might be related to each of the 3 real-world impacts.
- On Worksheet 4.1, have students record each real-world impact under all the engineering disciplines they think an impact could be connected with.
- As a review exercise, ask students to highlight or separately list the engineering disciplines into which they have placed any real-world impact.
- Finally, ask students to rank order these engineering disciplines from most to least interesting to themselves, using Worksheet 4.1 for recording rank order.

Extension – Education and career pathway exploration

EXERCISE 5.1

Starting to plan for a future in engineering

LEARNING OUTCOME

Familiarity with higher engineering education and potential employers of engineers.

ACTIVITY

Exploration of selected engineering field(s) and identification of potentially relevant schools and employers.

INSTRUCTIONS

Working from the rank ordering of engineering disciplines recorded on Worksheet 4.1, ask students to pick one or two disciplines for further exploration.

- a. Direct students to review the Career Guide and look for examples of activities or other references to the discipline(s) chosen for further exploration. Record page numbers and brief notes on findings in Worksheet 5.1.
- b. Point students to the information in the Career Guide about degrees granted by colleges, and ask them to pick out 3 schools offering degrees in their chosen discipline.
 - ➔ For each school, students do internet searches to find 3 things they like and 3 things they do not like about it.
- c. Point students to the information in the Career Guide about employers of engineers in their chosen disciplines.
 - ➔ For 2 employers of potential interest, students do research to identify the main line(s) of business, some of their prominent products, and 2 or 3 interesting or noteworthy facts about the company.

RESOURCE

Worksheet 5.1.

WORKSHEET 5.1

Choose one engineering discipline for exploration, and find three schools granting this degree. Next, provide 3 things you like and 3 you dislike about each school. Then, find two possible employers in this field, describing their main line of business, prominent product(s), and any other notable facts.

MY CHOSEN ENGINEERING DISCIPLINE:

SCHOOL 1 : _____

Three things I like about it:

Three things I dislike about it:

SCHOOL 2 : _____

Three things I like about it:

WORKSHEET 5.1 (CONTINUED)

Three things I dislike about it:

SCHOOL 3 : _____

Three things I like about it:

Three things I dislike about it:

WORKSHEET 5.1 (CONTINUED)

EMPLOYER 1 (main line of business, prominent product(s), and any other notable facts.)

EMPLOYER 2 (main line of business, prominent product(s), and any other notable facts.)

EMPLOYER 3 (main line of business, prominent product(s), and any other notable facts.)
