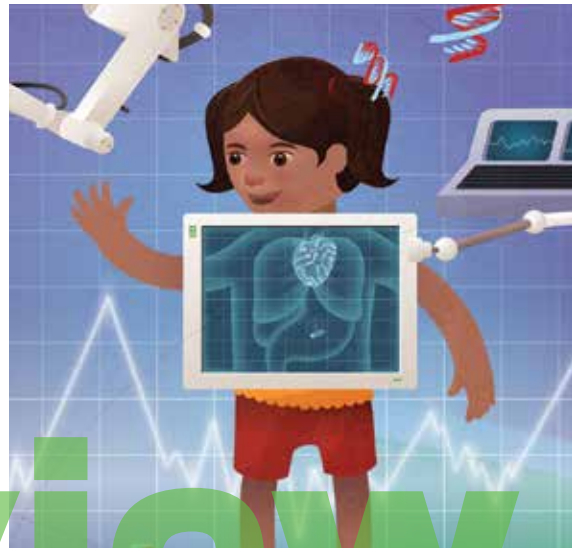


# Student Workbook

## Dream, Invent, Create a Career in Engineering

What's an engineer? Let's find out. Fun lessons, guidance, and insights about engineering careers.





## **BIOMEDICAL ENGINEERING** **THOUGHT QUESTIONS WORKSHEET**

Now that you have learned a bit about biomedical engineering, take some time to read and respond to the Thought Questions that appear below.

1. Some doctors are now able to see and treat their patients by examining them through a camera on their phones or computers. What would be the advantages and disadvantages of this type of treatment?

# Preview

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**BIOMEDICAL ENGINEERING** Thought Questions Worksheet (cont.)

2. What kinds of things do animals do better than humans? Is there anything we can learn from them?

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Preview

3. Remember the last time you were at the doctor's office? What tools or instruments did the doctor use during your visit? These are all things a biomedical engineer would help design and make. Pick out one of those tools and imagine how you could make it work better or help doctors learn more about their patients.

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**BIOMEDICAL ENGINEERING ADVANCED EXERCISE**  
**Biomimicry**

1. After completing the class discussion about examples of biomimicry, work with your group to pick out an animal with abilities or traits you wish you could have.

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2. With your animal in mind, decide what abilities or traits of this animal might be useful in some kind of technology that people could use.

Preview

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3. From these abilities or traits, pick out one that your group thinks could serve as the inspiration or example for a new product that could be useful for people in some way. The product can be anything imaginable, taken from any area of life or experience you can think of.

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## BIOMEDICAL ENGINEERING ADVANCED EXERCISE (CONT.)

4. Discuss among your group what this product would do, why it would be useful for people, and what it might look or be made of.

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5. Make a drawing with as much detail as you can of what your biomimicry-inspired product might look like. In your drawing, include information about how it was inspired by your animal as well as what benefits it would provide for people who use it.

# Preview

6. Prepare to present your biomimicry product to the class as if you were making a case for them to choose it as the best product in your class.

# BIOMEDICAL ENGINEERING

## CAREER REFLECTION



Preview

## What do biomedical engineers do?

Biomedical engineers combine engineering principles with medical sciences to design and create equipment, devices, computer systems, and software.

### Is this a good job?

A good job is one that you like to do and that connects with your skills, interests, and values. You should also think about what kind of need exists for people to do jobs that might appeal to you.

The need for biomedical engineers is expected to increase more than for most other jobs over the next ten years. And the typical salary for biomedical engineers is over two times higher than the typical salary for jobs overall. So if you like what you're learning about biomedical engineering, it might be a good job for you!



## **BIOMEDICAL ENGINEERING** Career Reflection



After doing the biomedical engineering lesson, read and answer the questions on the next page. They serve as a guided exercise for you to identify and assess skills and interests of yours that might make biomedical engineering a good career for you.

### **BIOMEDICAL ENGINEERING CAREER FACTS:**

- 10-year growth rate for biomedical engineering jobs: 7.0%
- 10-year growth rate for jobs overall: 3.7%
- Median salary, 2019: \$91,410
- Median individual salary overall, 2019: \$40,100

**BIOMEDICAL ENGINEERING**  
**Career Reflection Worksheet**

1. Think about what it felt like doing a biomedical engineering exercise. What parts, if any, did you enjoy? What parts did you not enjoy?

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2. What skills do you think you used in completing your exercise? Write down as many as you can think of (shoot for at least 5, like math, reading, collaboration, imagination, art, measurement, and so on).

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3. Looking back at this list of skills, pick the three you think you're best at. Which are the three hardest for you? How important do you think these skills would be in biomedical engineering? Why?

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**BIOMEDICAL ENGINEERING** Career Reflection Worksheet (cont.)

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4. Can you think of anything you have seen or used or learned about that could have been designed by a biomedical engineer? What was it? How did it work? How can you imagine making it work better?

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5. On a scale of 1-5, how much do you think you would like being a biomedical engineer, with 1 being a hole in the head and 5 being like cupcakes?

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## COMPUTER ENGINEERING

### THOUGHT QUESTIONS WORKSHEET

Preview

Now that you have learned a bit about computer engineering, take some time to read and respond to the Thought Questions that appear below.

1. Do you play video games? What devices do you play them on? Which one is your favorite? Engineers designed all of them!

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2. How do you think engineers could improve video games? What kinds of things would make them more fun?

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**COMPUTER ENGINEERING** Thought Questions Worksheet (cont.)

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3. What about phones and tablets, and any other gadgets? What do you wish they could do?

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## COMPUTER ENGINEERING ADVANCED EXERCISE

### Robotic Cups

Robotics involves designing, developing, and programming automated machines to do work for people. The programming involved in this work is one of the basic tasks involved in computer engineering. Think of a program like a set of instructions that a machine can read and then carry out. Good luck!

#### INSTRUCTIONS

1. From the members of your group, choose one person to serve as the “robot.” This person should move some place far enough away to keep him or her from hearing your group’s discussions.
2. Along with your group, use the six programming symbols below to make instructions for your group’s robot to follow in reproducing the Cup Stack given out by your teacher.
3. Write your instructions on a blank piece of paper and review or test it out to see if they include every move your robot needs to execute to successfully build the Cup Stack.
4. When your robot group member returns, give him or her the instructions and see if they work. Nobody should use any words or gestures to provide any directions to the robot, other than what is in the written instructions.
5. If you find a mistake in the program, you can stop the robot’s activity, send him or her back to the remote location, and fix, or de-bug, the instructions.
6. Repeat the exercise with new programs each time until everyone has a chance to play the role of robot.

↑ Pick up cup

↓ Put down cup

→ Move  $\frac{1}{2}$  cup width forward

← Move  $\frac{1}{2}$  cup width backward

↻ Flip cup right 90°

↻ Flip cup left 90°

## COMPUTER ENGINEERING Career Reflection



### What do computer engineers do?

Computer engineers develop and design new software programs and hardware components, test programs and hardware, identify issues, provide solutions, and market software and hardware to possible buyers.

#### Is this a good job?

A good job is one that you like to do and that connects with your skills, interests, and values. You should also think about what kind of need exists for people to do jobs that might appeal to you.

The need for computer engineers is expected to increase notably more than for most other jobs over the next ten years. And the typical salary for computer engineers is almost three times higher than the typical salary for jobs overall. So if you like what you're learning about computer engineering, it might be a good job for you!

## COMPUTER ENGINEERING Career Reflection



After doing the computer engineering lesson, read and answer the following questions. They serve as a guided exercise for you to identify and assess skills and interests of yours that might make computer engineering a good career for you.

### COMPUTER ENGINEERING CAREER FACTS:

- 10-year growth rate for computer engineering jobs: 20.6%
- 10-year growth rate for jobs overall: 3.7%
- Median salary, 2019: \$110,184
- Median individual salary overall, 2019: \$40,100

**COMPUTER ENGINEERING**  
**Career Reflection Worksheet**

1. Think about what it felt like doing a computer engineering exercise. What parts, if any, did you enjoy? What parts did you not enjoy?

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2. What skills do you think you used in completing your exercise? Write down as many as you can think of (shoot for at least 5, like math, reading, collaboration, imagination, art, measurement, and so on).

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3. Looking back at this list of skills, pick the three you think you're best at. Which are the three hardest for you? How important do you think these skills would be in computer engineering? Why?

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**COMPUTER ENGINEERING Career Reflection Worksheet (cont.)**

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4. Can you think of anything you have seen or used or learned about that could have been designed by a computer engineer? What was it? How did it work? How can you imagine making it work better?

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Preview

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5. On a scale of 1-5, how much do you think you would like being a computer engineer, with 1 being a hole in the head and 5 being like cupcakes?

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**ELECTRICAL ENGINEERING**  
**THOUGHT QUESTIONS WORKSHEET**

Preview

Now that you have learned a bit about electrical engineering, take some time to read and respond to the Thought Questions that appear below.

1. What are examples of electrical energy in our world?

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2. When a storm causes the electricity in your home to go out, what do your parents do? What do you miss the most? What problems could it create?

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**ELECTRICAL ENGINEERING Thought Questions Worksheet (cont.)**

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3. Imagine all the things you see at home, in school, or anywhere else that get plugged into an electrical outlet. All those things are products of electrical engineering. Pick out two electrical devices you know of and describe what they do. Choose one and then imagine how you could make it do what it does even better. What kinds of changes and improvements can you imagine adding to the device?

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## ELECTRICAL ENGINEERING ADVANCED EXERCISE

### Design a Net-Zero Energy Classroom

A net-zero energy classroom is one that generates as much energy as it uses. The classroom would use devices that generate power, efficiently use power, and conserve or recycle resources to enable students and teachers to learn and work comfortably in an environment that consumes less power than it produces. Believe it or not, net-zero energy use is possible to accomplish right now. Today, we are going to design a classroom on paper that uses power in some of the same ways that a net-zero energy classroom would in the real world.

#### INSTRUCTIONS

1. Look at your Net-Zero Energy Classroom Items.
  - Divide the set of items into two categories: items that would go **inside** a classroom, and items that **would** go **outside** a classroom.
2. Look at your Net-Zero Energy Classroom Design Sheet.
  - Draw windows on the wall where you would like them to be.
3. Identify North - South - East - West on the Net-Zero Energy Classroom Design Sheet.
4. Use tape or glue to place items inside and outside the classroom, according to how they are meant to be used.
5. Color in your completed classroom design.
6. Write a sentence or two that explains why you placed each item where you did.

## **ELECTRICAL ENGINEERING** **Career Reflection**



### **What do electrical engineers do?**

Electrical engineers design, develop, test, and supervise the manufacture of electrical equipment, products, and tools.

#### **Is this a good job?**

A good job is one that you like to do and that connects with your skills, interests, and values. You should also think about what kind of need exists for people to do jobs that might appeal to you.

The need for electrical engineers is expected to increase more than for most other jobs over the next ten years. And the typical salary for electrical engineers is over two times greater than the typical salary for jobs overall. So if you like what you're learning about electrical engineering, it might be a good job for you.

## **ELECTRICAL ENGINEERING** Career Reflection



After doing the electrical engineering lesson, read and answer the following questions. They serve as a guided exercise for you to identify and assess skills and interests of yours that might make electrical engineering a good career for you.

### **ELECTRICAL ENGINEERING CAREER FACTS:**

- 10-year growth rate for electrical engineering jobs: 8.5%
- 10-year growth rate for jobs overall: 3.7%
- Median salary, 2019: \$94,210
- Median individual salary overall, 2019: \$40,100

**ELECTRICAL ENGINEERING**  
**Career Reflection Worksheet**

1. Think about what it felt like doing an electrical engineering exercise. What parts, if any, did you enjoy? What parts did you not enjoy?

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2. What skills do you think you used in completing your exercise? Write down as many as you can think of (shoot for at least 5, like math, reading, collaboration, imagination, art, measurement, and so on).

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3. Looking back at this list of skills, pick the three you think you're best at. Which are the three hardest for you? How important do you think these skills would be in electrical engineering? Why?

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**ELECTRICAL ENGINEERING** Career Reflection Worksheet (cont.)

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4. Can you think of anything you have seen or used or learned about that could have been designed by an electrical engineer? What was it? How did it work? How can you imagine making it work better?

Preview

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5. On a scale of 1-5, how much do you think you would like being an electrical engineer, with 1 being a hole in the head and 5 being like cupcakes?

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**ENVIRONMENTAL ENGINEERING**  
**THOUGHT QUESTIONS WORKSHEET**

**Preview**

Now that you have learned a bit about environmental engineering, take some time to read and respond to the Thought Questions that appear below.

1. How do you think factories affect the environment? Could we get rid of factories altogether? Why or why not?

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2. Does your family recycle? What about your school? Why do you think this is important?

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**ENVIRONMENTAL ENGINEERING** Thought Questions Worksheet (cont.)

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3. Why is conservation of our natural resources important?

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# Preview

4. Think about the trees, the soil, and any bodies of water (streams, rivers, lakes, oceans, etc.) near where you live. Which one do you think is most at risk of being polluted? What can you imagine doing to make all these natural resources in your area safer for people to live with and use?

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## ENVIRONMENTAL ENGINEERING ADVANCED EXERCISE

### Building YourTown

In this exercise, you and your classmates will be serving as Members of the City Council for YourTown, USA. Your job as City Council Members will be to make decisions about how to spend the limited money you have in your budget on the goods and services that residents of YourTown need to live and be happy.

There are four areas of goods and services that the YourTown City Council has to figure out how to pay for:

1. **Selling/making things:** All the things we need to make and buy for daily life.
2. **Living/learning:** Buildings and facilities where we live, go to school, eat, and entertain ourselves.
3. **Playing/gathering:** Places we gather, exercise, enjoy the outdoors.
4. **Powering/managing:** The energy and services we need to make life in YourTown possible and sustainable.

Your teacher will lead an exercise in which students are divided into four groups. Each group will be in charge of making an argument to the rest of the class about why goods and services in their area should get the most money possible from the YourTown City Council. The table on the next page shows how much it costs to pay for different levels of goods and services in each of these areas.

Remember - deciding to spend \$2, \$3, or \$4 in one area of goods or services means that you also get all the goods and services described in the boxes above. For example, spending \$4 on Selling/making would buy video games for YourTown residents as well as all the goods in the \$1, \$2, and \$3 boxes above.

## ENVIRONMENTAL ENGINEERING ADVANCED ACTIVITY

Cost	Selling/ making	Living/ learning	Playing/ gathering	Powering/ managing
\$1	Food, clothing	Apartments, houses	Parking lots	Electricity and heat
\$2	Cars, furniture	Stores with basic stuff, schools	Some parks, playgrounds	Trash pickup, clean water, telephones
\$3	Toys, sports equipment	Stores with fun stuff, movie the- aters, restaurants	Many nice parks, playgrounds	Recycling, cable TV, internet, expensive health care
\$4	Video games	Amusement parks	Hiking/biking trails, ball fields	Free health care

But there's a catch. The YourTown City Council has only a limited budget to spend on goods and services: \$11. To pay for everything shown in the table would cost \$16.

So you and your classmates, serving as YourTown City Council Members, have to discuss and agree on a budget that spends money in each of the areas needed for living happily in YourTown, but only up to a maximum of \$11. In this exercise, you will have to figure out what areas of town life are worth paying the most for and what kinds of tradeoffs you would be willing to make in the daily lives of yourself and your fellow townspeople. Good luck!

Remember - deciding to spend \$2, \$3, or \$4 in one area of goods or services means that you also get all the goods and services described in the boxes above. For example, spending \$4 on Selling/making would buy video games for YourTown residents as well as all the goods in the \$1, \$2, and \$3 boxes above."

## ENVIRONMENTAL ENGINEERING Career Reflection



### What do environmental engineers do?

Environmental engineers use the principles of engineering, soil science, biology, and chemistry to develop solutions to environmental problems.

#### Is this a good job?

A good job is one that you like to do and that connects with your skills, interests, and values. You should also think about what kind of need exists for people to do jobs that might appeal to you.

The need for environmental engineers is expected to increase more than for most other jobs over the next ten years. And the typical salary for environmental engineers is over two times higher than the typical salary for jobs overall. So if you like what you're learning about environmental engineering, it might be a good job for you!

## **ELECTRICAL ENGINEERING** Career Reflection



After doing the environmental engineering lesson, read and answer the following questions. They serve as a guided exercise for you to identify and assess skills and interests of yours that might make environmental engineering a good career for you. After doing the electrical engineering lesson, read and answer the following questions. They serve as a guided exercise for you to identify and assess skills and interests of yours that might make electrical engineering a good career for you.

### **ENVIRONMENTAL ENGINEERING CAREER FACTS:**

- 10-year growth rate for environmental engineering jobs: 8.3%
- 10-year growth rate for jobs overall: 3.7%
- Median salary, 2019: \$88,860
- Median individual salary overall, 2019: \$40,100



**ENVIRONMENTAL ENGINEERING**  
**Career Reflection Worksheet**

1. Think about what it felt like doing an environmental engineering exercise. What parts, if any, did you enjoy? What parts did you not enjoy?

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2. What skills do you think you used in completing your exercise? Write down as many as you can think of (shoot for at least 5, like math, reading, collaboration, imagination, art, measurement, and so on).

Preview

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3. Looking back at this list of skills, pick the three you think you're best at. Which are the three hardest for you? How important do you think these skills would be in environmental engineering? Why?

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**ENVIRONMENTAL ENGINEERING** Career Reflection Worksheet (cont.)

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4. Can you think of anything you have seen or used or learned about that could have been designed by an environmental engineer? What was it? How did it work? How can you imagine making it work better?

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Preview

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5. On a scale of 1-5, how much do you think you would like being an environmental engineer, with 1 being a hole in the head and 5 being like cupcakes?

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