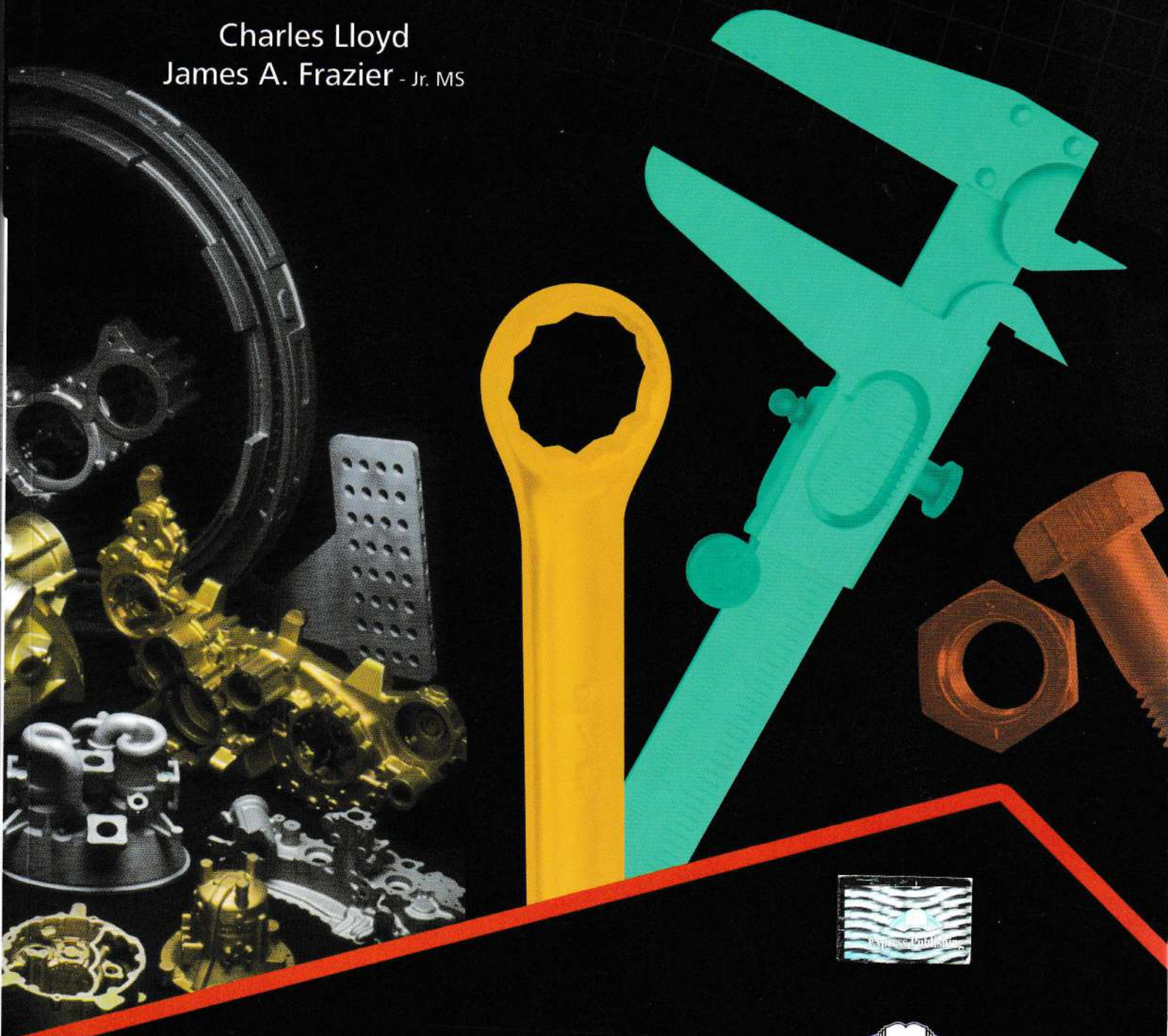
CAREER PATHS

Engineering

Charles Lloyd
James A. Frazier - Jr. MS



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Engineering

Book 1

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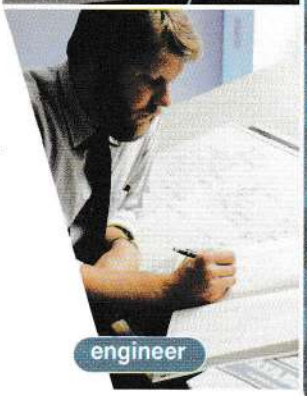


TOP CAREER MAGAZINE VOL. 4 NO. 6

TODAY'S TOP CAREERS: Engineering

Engineering is one of today's fastest growing careers. That's because **engineers** work in so many areas. Some engineers **design** roadways. Others **inspect** very complicated **machines**. But no matter where they work, they all have two things in common: math and science. **Disciplines** like **mathematics** and **physics** are a must for any engineer. And so becoming an engineer requires extensive study.

Engineers **develop** fascinating new ideas. These new ideas change the world in big ways. Engineers also create the **technologies** that make our lives easier. The field of engineering truly is crucial in today's modern world. It is expanding every day, and is a great field to go into.

Reading

2 Read this magazine article. Then, choose the correct answers.

1 What is the magazine article mainly about?

- **A** the importance of mathematics
- **B** the machines that engineers design
- **C** the work and ideas in engineering
- **D** how new technologies change the world

2 According to the article, which of the following do engineers NOT do?

- **A** design roadways
- **B** analyze machines
- **C** develop new ideas
- **D** create new materials

3 What can be inferred about students of engineering?

- **A** They take classes in physics.
- **B** They do not take classes in English.
- **C** They attend an extra year of college.
- **D** They design machines in class.

Vocabulary

3 Check (✓) the sentence that uses the underlined word correctly.

1 ___ **A** A <u>machine</u> is a branch of instruction or learning.
___ **B** To <u>design</u> something is to plan how it will look and function.

2 ___ **A** To <u>inspect</u> something is to examine it carefully.
___ **B** <u>Mathematics</u> is a science that studies matter.

3 ___ **A** <u>Engineering</u> is the study of quantity, structure, and change.
___ **B** To <u>develop</u> something is to create it or cause it to grow.

4 ___ **A** <u>Technology</u> is a type of machine that makes life easier.
___ **B** <u>Physics</u> is the art of using the knowledge gained by science.

5 ___ **A** A <u>machine</u> is a device that has multiple parts and does work.
___ **B** A <u>discipline</u> is a person who applies scientific knowledge.

4 **Use the words from the word bank to fill in the blanks.**

WORD BANK

mathematics engineering engineer
physics disciplines

1 Daniel wants to be a(n) _____ .
2 _____ investigates how mass and movement interact.
3 _____ classes are for students who want to build structures.
4 _____ includes studying addition and division.
5 This university offers degrees in many different _____ .

5 **Listen and read the article. How do engineers change our lives?**

Listening

6 **Listen to a conversation between an engineer and a new employee. Mark the following statements as true (T) or false (F).**

1 __ The woman just left the engineering lab.
2 __ The woman is there to inspect a design.
3 __ The man designed the vehicle's engine.

7 **Listen again and complete the conversation.**

Engineer 1: Excuse me. Do you know where the **1** _____ lab is?
Engineer 2: Absolutely. Right this way. Are you new here?
Engineer 1: Yes. I'm Sarah Gladstone. I'm here to **2** _____ the company's new engine **3** _____ .
Engineer 2: Nice to meet you. I'm Bob Sanders. I'm designing the vehicle that the **4** _____ is going into.
Engineer 1: I see. How's it going?
Engineer 2: Pretty well. But we're still working on some of the **5** _____ .
Engineer 1: Well, some projects **6** _____ _____ than others.
Engineer 2: Exactly. Here's the engineering lab. Good luck with your first day!

Speaking

8 **With a partner, act out the roles below, based on task 7. Then switch roles.**

USE LANGUAGE SUCH AS:

Do you know where the ... is?
I'm here to analyze the ...
But we're still working on ...

Student A: You are a new employee. Talk to Student B about:

- location of a room
- your project
- Student B's project

Make up a name for the employee.

Student B: You work with Student A. Answer his or her questions.

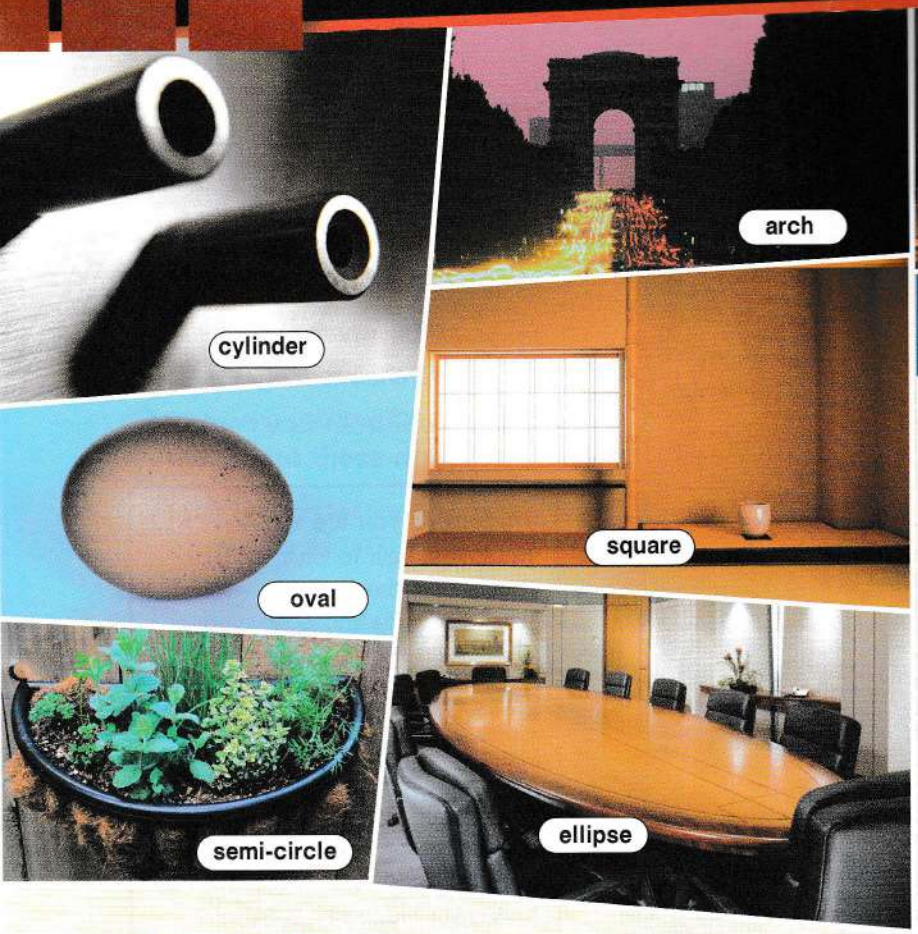
Make up a name for the employee.

Writing

9 **You are an engineer. Use the conversation from Task 8 to complete a diary entry about your first day at a new job 100-120 words). Write about:**

- someone you met and what they do
- what you are doing in your new job
- a room you were shown to
- Use today's date.

2 Shapes



The Roman Coliseum

The Importance of Shapes in Architecture and Engineering

Most students learn about **geometric** shapes in school. But **architects** also need to understand them. In fact, those basic shapes appear in many historical buildings. For example, look at the Roman Coliseum.

Although most buildings have a **rectangle** or **square** shape, the Coliseum is an **ellipse,** or **oval**. It features many **arches** supported by columns, which are **cylinders**. They provide support.

Some parts of the Coliseum have extended arches, or **vaults**, which form **prisms**. These hallways have high ceilings in the shape of a **semi-circle**.

These shapes are in modern architecture, too. They add support, structure, and style, all at the same time.

Get ready!

1 Before you read the passage, talk about these questions.

1 How do shapes relate to engineering?
2 What different shapes do engineers use to construct buildings?

Reading

2 Read this blog entry. Then, choose the correct answers.

1 What is the blog mainly about?
- **A** how an ancient building was constructed
- **B** why shapes are important to architects
- **C** why students learn about geometric shapes
- **D** which shapes provide the best support

2 A column is an example of a(n)
- **A** cylinder
- **B** oval
- **C** square
- **D** arch

3 Which shape is NOT used in the Coliseum?
- **A** a semi-circle
- **B** an oval
- **C** a rectangle
- **D** a circle

Vocabulary

3 Match the words (1-6) with the definitions (A-F).

1 __ semi-circle
2 __ ellipse
3 __ rectangle
4 __ geometric
5 __ prism
6 __ vault

- **A** a closed arc that resembles a flat circle
- **B** a shape with four sides and right angles
- **C** a shape that has three dimensions
- **D** a shape that is half of a circle
- **E** relating to the study of shapes
- **F** an arch that extends through a structure

4 Write a word that is similar in meaning to the underlined part.

1 Meg's table is <u>a round shape that is longer than it is wide</u>.
o _ _ l
2 The building is a <u>shape with four equal sides</u>.
s _ _ a _ e
3 Many old buildings have <u>curved shapes over the openings</u>.
_ r _ h _ _
4 Amy wants to be a <u>person who designs structures</u>.
_ r _ _ i _ _ _ t
5 Laura's cup is a <u>shape with two circular ends</u>.
c _ _ i _ d _ r

5 Listen and read the blog. Why are shapes important nowadays?

Listening

6 Listen to a conversation between an architect and her client. Mark the following statements as true (T) or false (F).

1 __ The woman sent the man building designs.
2 __ The client wants a bigger room.
3 __ A vaulted ceiling saves energy.

7 Listen again and complete the conversation.

Architect: Keystone Architecture. This is Donna.
Client: Hi, Donna, it's Jim North. I'm calling about the **1** _____ that you sent me.
Architect: Is there a problem?
Client: Well, I'm wondering, why do we need the **2** _____ on the ceilings?
Architect: Oh, vaulted ceilings create more **3** _____.
Client: So they make rooms look **4** _____?
Architect: Yes, exactly. The only downside is that they can **5** _____ energy costs.
Client: In that case, I'd rather go with flat ceilings so we're not **6** _____ energy.

Speaking

8 With a partner, act out the roles below, based on task 7. Then switch roles.

USE LANGUAGE SUCH AS:

I'm calling about the ...
Why do we need the ...
The only downside is that ...

Student A: Student B is an architect. Talk to him or her about the plans for your new building. Include:

- ceiling design
- space
- energy usage

Make up a name for the client.

Student B: You are an architect designing Student A's new building. Answer Student A's questions.

Make up a name for the architect.

Writing

9 Use the conversation from Task 8 to complete the client's notes.

BUILDING **DESIGN**

Question: Why have _____?

Benefits: _____

_____

Drawbacks: _____

_____

Decision: _____

_____

_____

3 Materials

BUILD CO

Bid Sheet

There are three types of glass we could use:
Standard **Glass**: $4.50/square foot.
Coated Glass: $5.50/square foot. Blocks ultraviolet light.
Wire **Reinforced** Glass: $6.75/square foot. Stronger and more decorative.

The following types of steel are available:
Standard **Steel**: $50/square foot.
Stainless steel: $75/square foot. Does not rust.

I can give you a bid on **lumber** if you tell me what type you need.

We have several options for concrete and tiles:
Concrete: $8/square foot.
Textured concrete: $15/square foot. Has a polished, decorative appearance.
Tiles:
Ceramic: $7/square foot.
Porcelain: $15/square foot. More decorative than ceramic.

Get ready!

1 Before you read the passage, talk about these questions.

1 What kinds of material are in your home?
2 How do engineers decide what materials to use?

Reading

2 Read this bid sheet from a construction company. Then, mark the following statements as true (T) or false (F).

1 __ Coated glass lets ultraviolet light in.
2 __ Stainless steel costs more than standard steel.
3 __ Ceramic tiles are less decorative than porcelain tiles.

Vocabulary

3 Write a word that is similar in meaning to the underlined part.

1 Most toilets are made of <u>a high quality form of ceramic</u>.
_ _ _ c _ _ a _ _
2 <u>Steel that does not rust or stain</u> stays shiny for a long time.
_ _ _ i _ l _ _ s s _ e _ _
3 The contractor needs <u>wood that is used in construction</u>.
_ _ m _ _ r
4 Sidewalks are <u>a material made of cement and crushed rocks</u>.
c _ _ c _ _ t _

4 Match the words (1-7) with the definitions (A-G).

1 __ coated
2 __ reinforced
3 __ tile
4 __ ceramic
5 __ textured
6 __ steel
7 __ glass

A covered by some type of material
B having details added to a surface
C a solid material made for materials such as clay
D a solid, transparent material used in windows
E a material that often covers walls or floors
F made stronger by some type of material
G a strong material made mostly from iron

5 Listen and read the bid. How many types of concrete are available?

Listening

6 Listen to a conversation between two engineers. Choose the correct answers.

1 What is the conversation mainly about?
A how expensive ceramic tiles are
B why the budget is so low
C which materials are affordable
D where to buy cheaper materials

2 Which material will be used?
A ceramic tiles
B textured concrete
C stainless steel
D porcelain

7 Listen again and complete the conversation.

Engineer 1: The **1** _____ for the new office building looks a little high.
Engineer 2: Yeah, but our budget might not **2** _____ _____.
Engineer 1: Maybe we can make it cheaper. Let's look at some alternative **3** _____.
Engineer 2: Okay. What materials are you thinking about changing?
Engineer 1: Well, the estimate included **4** _____ _____.
Engineer 2: What's wrong with that? Porcelain tiles **5** _____ _____.
Engineer 1: But they're also really expensive. We could save money by getting **6** _____ _____ instead.
Engineer 2: That's a good idea.

Speaking

8 With a partner, act out the roles below, based on task 7. Then switch roles.

USE LANGUAGE SUCH AS:
The estimate for the ... looks ...
Let's look at some alternative ...
It's really expensive.

Student A: You got a high estimate for a construction project. Talk to Student B about:
- estimate and budget
- material costs
- materials to use

Student B: You are an engineer. Answer Student A's questions.

Writing

9 Use the bid sheet and the conversation from Task 8 to complete the order form for your project. Make up a name for the engineer.

BUILD CO

MATERIALS ORDER

Engineer Name: _____

Materials (Check box to order item)

_____ ☐
_____ ☐
_____ ☐
_____ ☐
_____ ☐

4 Tools

INSTRUCTIONS FOR LAMP REPAIR

1 Secure the appliance in a **vise** to hold the lamp in place and free your hands.
2 Remove **screws** from the covering plate with a **screwdriver** or an electric **drill**. Remove the plate to reveal the wiring inside.
3 Locate the wiring causing the bad connection. Using **pliers**, **clip** the faulty connection.
4 **Strip** the insulation from the faulty wire with a **wire stripper**.
5 Using the **soldering iron**, apply **solder** to the bare wires to make a new connection.
6 Replace the insulation and put the wire back into the lamp.
7 Put the plate back and replace the screws to seal the base.
8 Test the lamp to make sure it works.

Get ready!

1 Before you read the passage, talk about these questions.

1 What jobs do different tools do?
2 Why is it important to have the right tools?

Reading

2 Read this section from an instruction manual. Then, choose the correct answers.

1 What are the instructions about?
- **A** installing a vise
- **B** fixing faulty wiring
- **C** installing new appliances
- **D** safely using a soldering iron

2 According to the manual, what tool is used to clip wiring?
- **A** pliers
- **B** an electric drill
- **C** a wire stripper
- **D** a soldering iron

3 What can you infer about the repair?
- **A** It is very dangerous.
- **B** It requires buying new wire.
- **C** It fixes insulation problems
- **D** It assumes there is faulty wiring.

Vocabulary

3 Match the words (1-7) with the definitions (A-G).

1 __ vise
2 __ wire stripper
3 __ screw
4 __ screwdriver
5 __ soldering iron
6 __ drill
7 __ pliers

- **A** makes holes or inserts and removes screws
- **B** twisted by hand to insert or remove screws
- **C** used to grab, pull and cut objects
- **D** piece of metal used to fasten objects
- **E** removes insulation from wiring
- **F** holds an object in place
- **G** heats and connects metal objects together

4 Choose the word that is closest in meaning to the underlined part.

1 Use the pliers to <u>cut</u> the wiring.
A clip **B** drill **C** strip

2 Use soft metal to <u>fuse</u> the wires.
A vise **B** clip **C** solder

3 <u>Remove the cover from</u> the wire.
A clip **B** strip **C** drill

5 Listen and read the instruction manual. What problem does the manual give instructions on how to fix?

Listening

6 Listen to a telephone conversation between an engineer and a shop owner. Mark the following statements as true (T) or false (F).

1 ___ The woman needs a soldering iron.
2 ___ The woman is repairing a small circuit.
3 ___ The owner offers two tool options.

7 Listen again and complete the conversation.

Owner: Hello, ma'am. Can I help you find anything?
Engineer: Yes. I'm **1** _____ _____ a soldering iron.
Owner: Okay. We have a few different models. Can I ask what you'll be using it for?
Engineer: I need to repair some **2** _____ .
Owner: Well, we have the Lanford 250 or the Hilldale 400.
Engineer: Okay. What's the **3** _____?
Owner: The Lanford 250 is for **4** _____ wiring. The Hilldale 400 is **5** _____ _____ small circuits.
Engineer: I think **6** _____ _____ the Lanford.

Speaking

8 With a partner, act out the roles below, based on task 7. Then switch roles.

USE LANGUAGE SUCH AS:

I'm looking for a ...
Can I ask what you'll be ...?
What's the difference?

Student A: You own a hardware store. Ask Student B questions to find out about:

- tool needed
- choices
- use of each tool

Student B: You need a tool. Talk to Student A about which one to buy.

Writing

9 Use the conversation from Task 8 to complete the engineer's notes.

TOOLS RECOMMENDED

Tool 1: _____

Purpose: _____

_____

Tool 2: _____

Purpose: _____

_____

Selection: _____

_____

_____

5 Energy

STRETCHING SEATBELT TEST:

Abstract

Background: Passengers who are riding in a car have **potential energy**. In a crash, a car **decelerates** quickly. This causes the passengers' potential energy to become **kinetic energy**. Passengers wearing seatbelts stop. With non-stretching seatbelts, the passenger's **stopping distance** is short. Stretching seatbelts increase this distance. The **work-energy principle** shows that a slightly greater stopping distance exerts less force on passengers.

Results: Tests show that stretching seatbelts reduce the **force** and **G**s that passengers feel.

Conclusions: The new seatbelts reduce injuries. This is because less **work** is done on passengers. Instead, most of the passenger's kinetic energy **transfers** to the belt.

Get ready!

1 Before you read the passage, talk about these questions.

1 What types of energy are there?

2 How do engineers make cars safer?

Reading

2 Read this abstract from a seatbelt test. Then, mark the following statements as true (T) or false (F).

1 ___ Kinetic energy becomes potential energy in a crash.

2 ___ Shorter stopping distances exert less force on people.

3 ___ Stretching seatbelts cause less work to be done on people.

Vocabulary

3 Read the sentence pairs. Choose where the words best fit in the blanks.

1 **decelerate / stopping distance**

The _____ of this car is dangerously long.

Drivers _____ when they press the brakes.

2 **kinetic energy / potential energy**

A still object has _____.

A moving object has _____.

3 **force / work**

When you kick a ball, the _____ moves it forward.

A machine does _____ when it moves another object.

4 Match the words (1-4) with the definitions (A-D).

1 __ abstract
2 __ work-energy principle
3 __ G
4 __ transfer

A a summary of an article, document, or other text
B to move from one object to another
C the unit of force that equals the force of gravity
D the idea that a moving object's energy equals the distance it moves

5 Listen and read the abstract. How do the new seatbelts reduce injuries?

Listening

6 Listen to a conversation between two engineers. Choose the correct answers.

1 What is the conversation mostly about?
A the drawbacks of longer stopping distances
B the benefits of a new seatbelt design
C the safety of non-stretching seatbelts
D the failure of a new seatbelt design

2 The woman thinks the new seatbelt will
A fail the test next week.
B transfer potential energy.
C shorten the stopping distance.
D be safer than the current seatbelts.

7 Listen again and complete the conversation.

Engineer 1: I heard you're working on the new seatbelt designs.
Engineer 2: Yes, I am. I think I can make them **1** _____ _____ our current models.
Engineer 1: Really? How can you do that?
Engineer 2: All I have to do is extend the **2** _____ _____.
Engineer 1: How? Are you going to make the seatbelts stretch more?
Engineer 2: Yes, exactly. That way, the passenger's **3** _____ _____ will be transferred to the **4** _____.
Engineer 1: That's a **5** _____ _____ idea.
Engineer 2: Yeah, I think it is. We're **6** _____ it next week.

Speaking

8 With a partner, act out the roles below, based on task 7. Then switch roles.

USE LANGUAGE SUCH AS:

How can you do that?

Are you going to make the seatbelts ...?

We're testing it next week.

Student A: You have a new seatbelt design. Talk to Student B about:

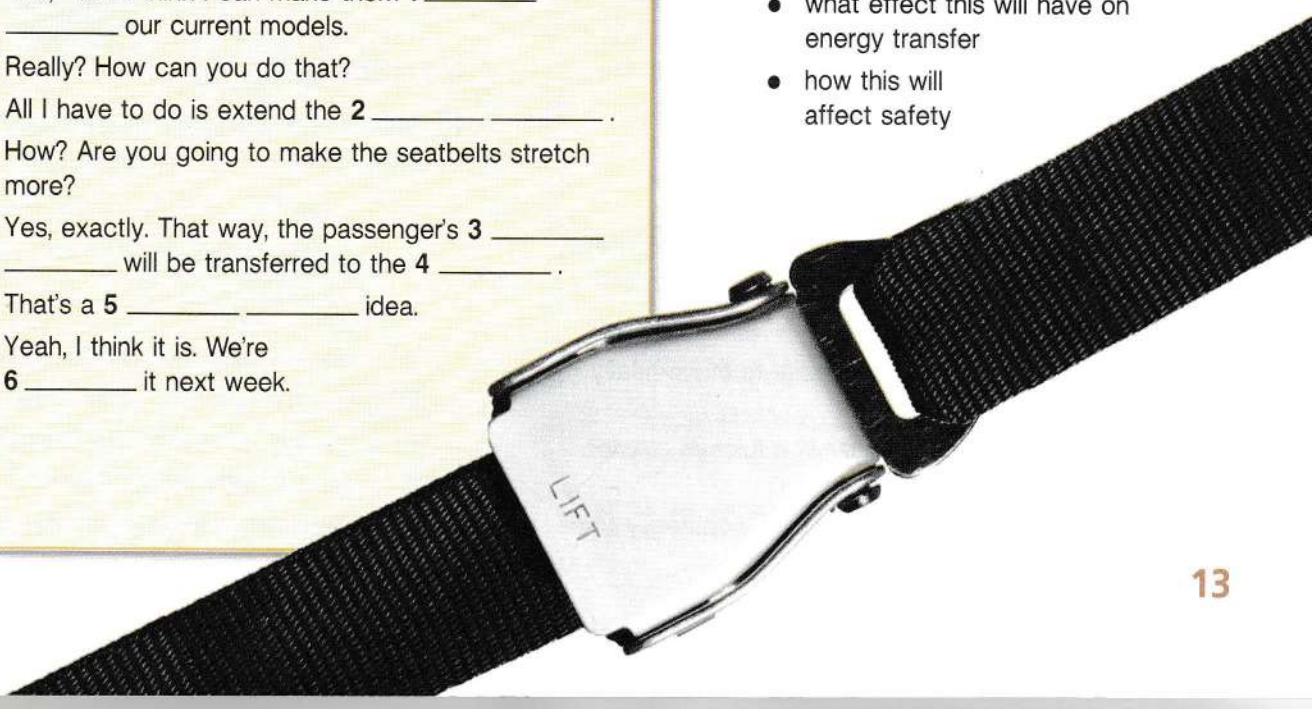
- safety
- stopping distance
- energy transfer

Student B: You are an engineer. Discuss the effects of the new seatbelt design with Student A.

Writing

9 You are an engineer. Use the conversation from Task 8 to complete your notes on stretching seatbelts (100-120 words). Write about:

- how to extend a passenger's stopping distance
- what effect this will have on energy transfer
- how this will affect safety

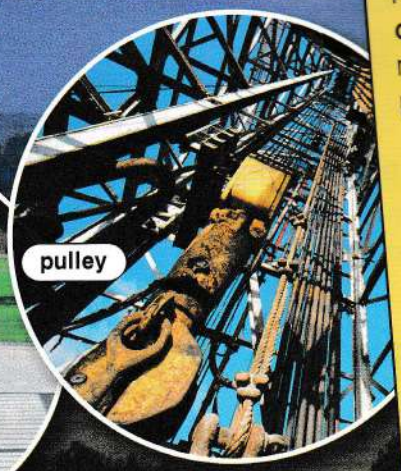


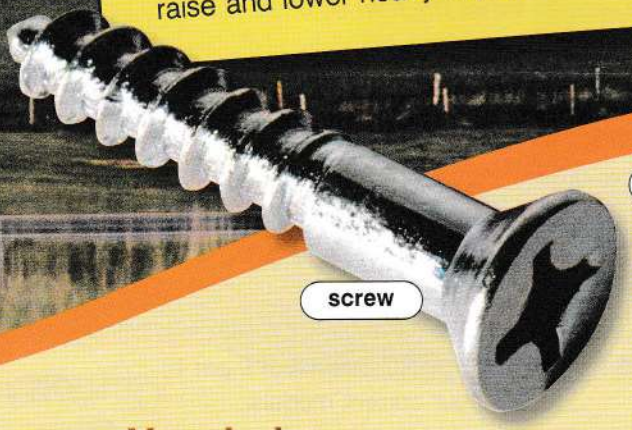
6 Simple Machines

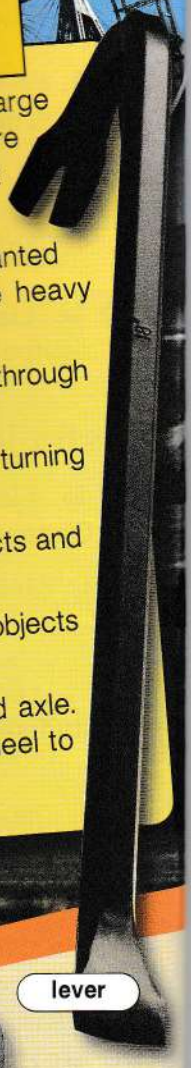
Get ready!

1 Before you read the passage, talk about these questions.

1 What are some simple machines?
2 How do simple machines make work easier?







Simple Machines

People often think of machines as large **complicated** devices. However, there are many types of **simple machines** that people use every day.

Inclined Plane - This machine is a slanted surface that makes it easier to move heavy **loads**.

Screw - This machine is turned to drill through wood easily.

Lever - A lever creates **leverage** by turning a long arm against a **fulcrum**.

Wedge - This machine can split objects and push apart the pieces.

Wheel and Axle - This machine rolls objects to reduce friction.

Pulley - A pulley is like a wheel and axle. It uses a rope wrapped around a wheel to raise and lower heavy objects.

Reading

2 Read this passage from a textbook. Then, mark the following statements as true (T) or false (F).

1 __ A wedge makes it easier to move heavy objects.
2 __ Turning a lever against a fulcrum creates friction.
3 __ Pulleys are used to lift and drop heavy items.

Vocabulary

3 Match the words (1-5) with the definitions (A-E).

1 __ lever
2 __ simple machine
3 __ wheel and axle
4 __ load
5 __ wedge

A a tool with one wide end and one pointed end
B a machine with few or no moving parts
C an amount of weight that is lifted or carried
D a bar that rests on a fulcrum
E a circular object with a rod through it

4 **Use the words from the word bank to fill in the blanks.**

WORD BANK

complicated pulley fulcrum
leverage inclined plane

1 A lever provides _____ to lift heavy items.
2 Eric is constructing a(n) _____ with wheels and rope.
3 Not all machines are _____ .
4 A ramp with a high and low end is a(n) _____ .
5 A lever requires a(n) _____ .

5 **Listen and read the passage. What is a wedge used for?**

Listening

6 **Listen to a conversation between a student and teacher. Mark the following statements as true (T) or false (F).**

1 __ The teacher asks students to define simple machines.
2 __ The woman asks the teacher to define a pulley.
3 __ There is a simple machine just outside the class.

7 **Listen again and complete the conversation.**

Teacher: Hi, Paula. Did you have a question?
Student: Yes. Did you say that people use **1** _____ _____ every day?
Teacher: Yes. We all use them.
Student: Um, besides the **2** _____ on my bike, I can't **3** _____ _____ any.
Teacher: Well, think about elevators. They use **4** _____ to raise and lower the car.
Student: **5** _____ _____ . I never thought of that.
Teacher: And we have an **6** _____ _____ right outside this classroom.
Student: Oh yeah, the wheelchair ramp.

Speaking

8 **With a partner, act out the roles below, based on task 7. Then switch roles.**

USE LANGUAGE SUCH AS:

Did you have a question?
Well, think about ...
I never thought of that.

Student A: You are a teacher. Help a student think of simple machines used everyday. Include:

- wheels
- pulleys
- inclined planes

Make up a name for your student.

Student B: You are a student. Talk to Student A about simple machines.

Writing

9 **Use the conversation from Task 8 to complete the student's notes. Use today's date.**

Engineering 101 Notes

Date: _____

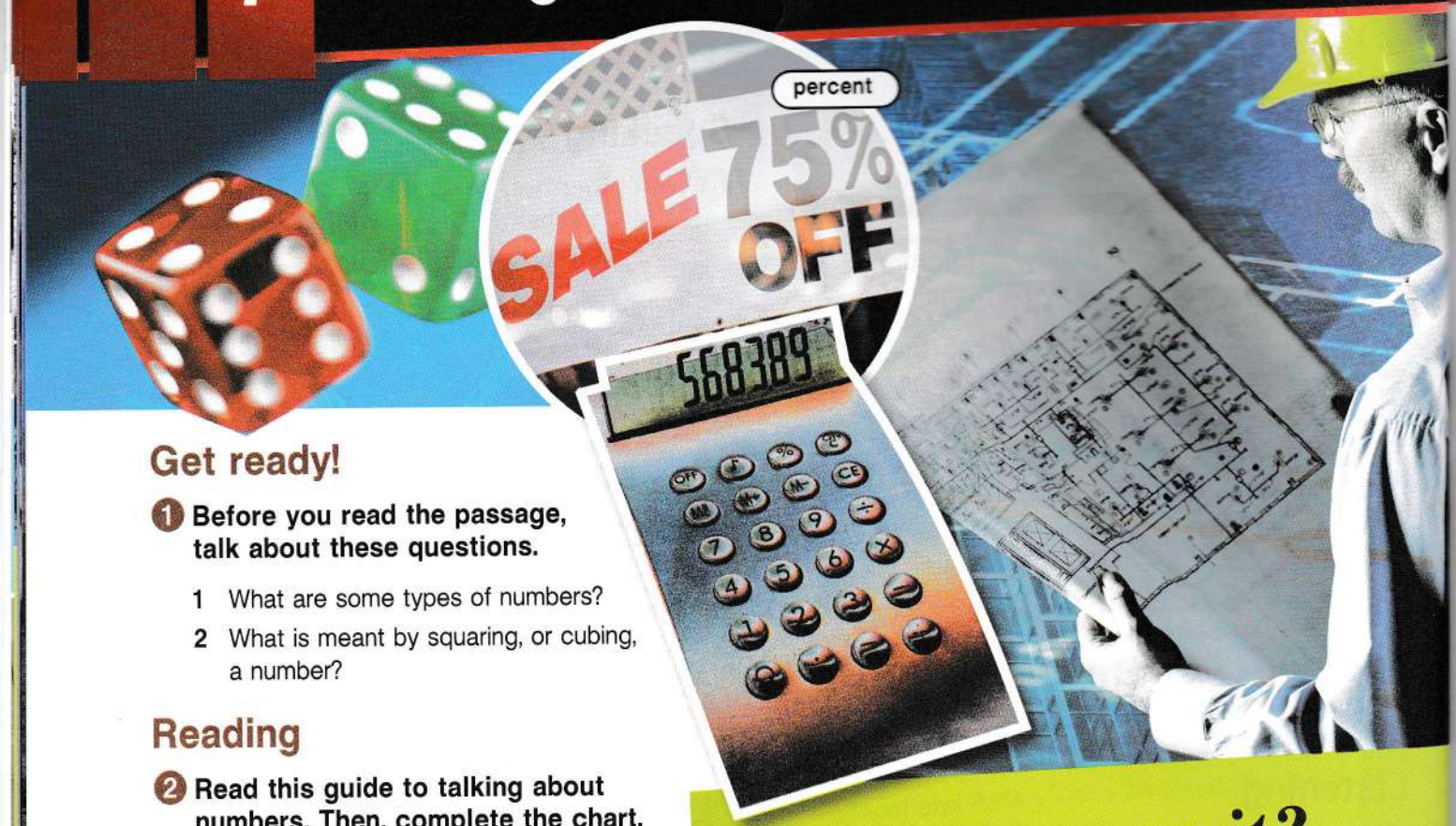
Examples of Simple Machines

1 Simple Machine: _____
Example: _____

2 Simple Machine: _____
Example: _____

3 Simple Machine: _____
Example: _____

7 Working with numbers



Get ready!

1 Before you read the passage, talk about these questions.

1 What are some types of numbers?
2 What is meant by squaring, or cubing, a number?

Reading

2 Read this guide to talking about numbers. Then, complete the chart.

Symbol	How it is Said
0.09	1 _____
2 _____	ten to the fifth power
32%	3 _____
0.1	4 _____
3^3	5 _____
6 _____	eleven squared

Vocabulary

3 Match the words (1-6) with the definitions (A-F).

1 __ times
2 __ percent
3 __ equals
4 __ cubed
5 __ squared
6 __ exponent

A multiplied twice by itself
B an amount out of 100
C a number showing powers of multiplication
D multiplied three times by itself
E multiplied by
F is the same as

How do they say it?

Symbol	*Interpretation*	*Example*
=	**equals**	5 + 2 = 7 five plus two equals/is seven
%	**percent**	5% five percent
0.5	five **tenths**	0.6 six tenths zero point six
0.05	five **hundredths**	0.06 six hundredths
0.005	five **thousandths**	0.006 six thousandths
10^2	ten **squared**	$5^2 + 3$ five squared plus three
10^3	ten **cubed**	$5^3 + 4$ five cubed plus four
10^4	When using **exponents** higher than three, say, "to the X power." ten **to the fourth power**	10^5 / 10^6 / 10^7 ten to the fifth power ten to the sixth power ten to the seventh power
5.2×10^4	scientific notation	5.3×10^6 five point three **times** ten to the sixth power

4 **Write the word that is closest in meaning to the underlined part.**

1 The sample weighs <u>0.8</u> of a gram.
e _ g _ _ t _ _ t _ _

2 The answer is 1.12X<u>10</u>^{6}.
t _ _ t _ _ _ _ s _ _ _ _ p _ _ e r

3 The amount is off by just <u>0.004</u>.
f _ _ r t _ _ u _ _ n _ _ _ s

4 The design must be accurate to <u>0.01</u> of an inch.
o _ _ _ u _ _ r _ _ t _

5 🎧 **Listen and read the guide. How do you say five tenths as a percentage?**

Listening

6 🎧 **Listen to a conversation between two engineers. Mark the following statements as true (T) or false (F).**

1 __ The woman found an error in the man's work.
2 __ The woman reviewed the calculations twice.
3 __ The error was caused by an incorrect exponent.

7 🎧 **Listen again and complete the conversation.**

Engineer 1: Kevin, could you **1** _____ _____ _____ at these numbers?
Engineer 2: Sure. Is there a problem?
Engineer 1: Yes. I've checked the calculations twice but something is **2** _____.
Engineer 2: OK. Let's see ... um, right here you multiplied by ten to the **3** _____ _____.
Engineer 1: Uh, yes, I did. Is that wrong?
Engineer 2: Well, look at the formula. That's the wrong **4** _____. You need to multiply by **5** _____ _____ _____ ninth power.
Engineer 1: Oh, I see. You're right. Thank you. I don't know how I missed that.
Engineer 2: **6** _____ _____. Hopefully that fixes it.

Speaking

8 **With a partner, act out the roles based on task 7. Then switch roles**

USE LANGUAGE SUCH AS:

I've checked the calculations ...
You multiplied by ...
I don't know how I missed that.

Student A: You noticed an error in a calculation. Talk to Student B about:

- your review
- exponents
- correct formula

Make up a name for a co-worker.

Student B: Your co-worker made a calculation error. Help Student A solve the problem.

Writing

9 **You are an engineer. Use the conversation from Task 8 to complete the engineer's report (100-120 words). Write about:**

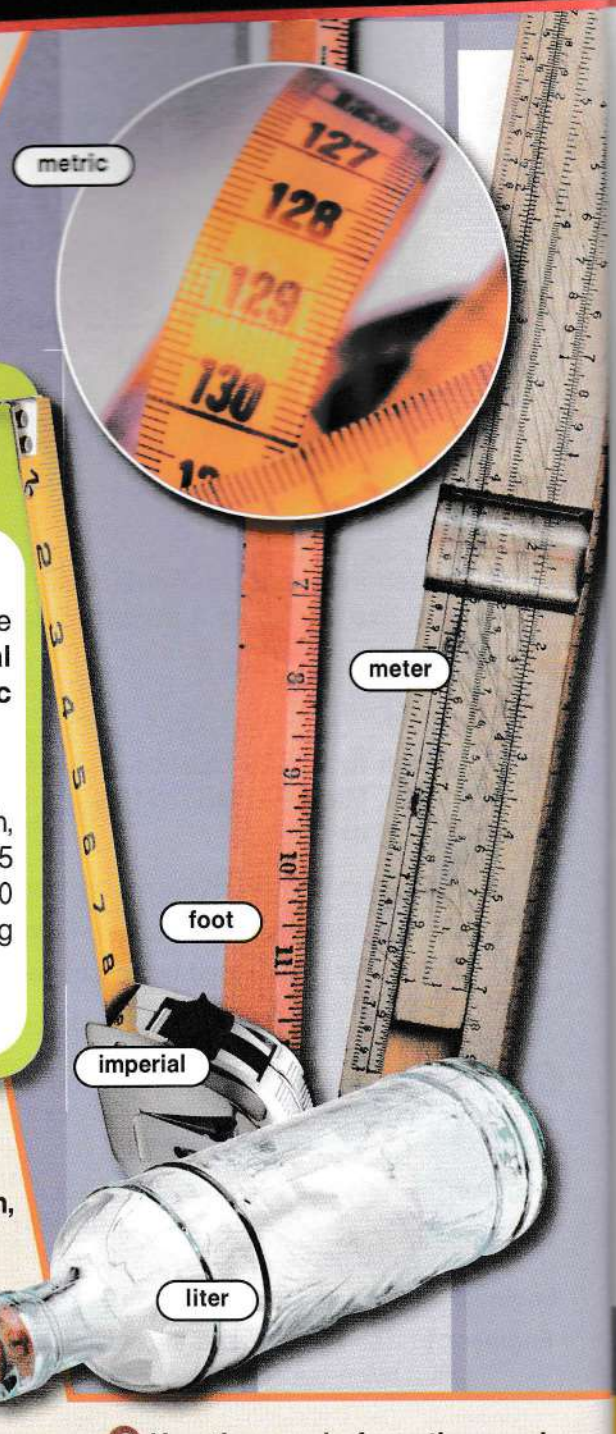
- a mistake you made
- how it was corrected
- the result

8 Types of measurement

Get ready!

1 Before you read the passage, talk about these questions.

1 What types of measurement systems are there?
2 Why do engineers label all measurements?



To: kvanderpol@arnhemassociates.com
From: rdegraaf@arnhemassociates.com
Subject: Measurement confusion

Karen,

We have a problem with the project we're working on. The American engineer we are working with is using **imperial** measurements. This is incorrect. We all need to use the **metric** system.

Please inform the American engineer of the following:
The pipes we are using are 4.5 **meters** (450 **centimeters**) each, not 4 **feet**, 5 **inches**. Also, each pipe holds 15 **liters**, not 15 **gallons**. And the weight of the frame is no more than 20 **kilograms**, instead of 20 **pounds**. Mistakes like this make a big difference. Someone needs to contact him about this.

Rob

Reading

2 Read this email from an engineer to his co-worker. Then, mark the following statements as true (T) or false (F).

1 __ The engineers must use the imperial system.
2 __ The pipes are 4 feet, 5 inches long.
3 __ The frame must weigh 20 kilograms or less.

Vocabulary

3 Write a word that is similar in meaning to the underlined part.

1 The boy is over one <u>hundred centimeters</u> tall! _ e _ _ r
2 Is that 200 <u>imperial weight measurements</u> or kilograms? p _ _ n _ _
3 There is only one <u>thousand milliliters</u> of soda left. _ _ t _ r
4 The measurement is just one <u>one-hundredth of a meter</u> off. _ e _ _ i _ _ t _ _
5 The <u>United States' system of measurement</u> uses gallons. _ _ _ e r _ _ l _ y _ t _ _
6 A ruler is a <u>twelve inch length</u> long. _ o _ t

4 Use the words from the word bank to fill in the blanks.

WORD BANK

metric gallons
kilograms inch

1 Get seven _____ of water.
2 Daniel's design only weighs seventeen _____.
3 The _____ system is used worldwide.
4 That worm is less than a(n) _____ long!

5 🎧 **Listen and read the email. What was the source of the confusion?**

Listening

6 🎧 **Listen to a conversation between two engineers. Choose the correct answers.**

1 What is the conversation mainly about?

- **A** a measurement confusion problem
- **B** a measurement conversion problem
- **C** a language translation problem
- **D** a manufacturing problem

2 What can be inferred about the man?

- **A** He plans to make new pipes.
- **B** He does not have time to fix his mistake.
- **C** He always works with European engineers.
- **D** He has never used metric measurements before.

7 🎧 **Listen again and complete the conversation.**

Engineer 1: Hello, Timothy. We need to talk about the **1** _____ you're using.

Engineer 2: Okay. What's up?

Engineer 1: Well, you're using **2** _____ measurements instead of **3** _____ measurements.

Engineer 2: Oh, no! I can't believe I made such a simple mistake!

Engineer 1: It's okay. There's plenty of time to fix it.

Engineer 2: All right. So that means we need much **4** _____ pipes, right?

Engineer 1: That's it. We need pipes that are 4.5 **5** _____, not 4 feet, 5 **6** _____.

Engineer 2: I see. Sorry about all this. I almost never work with the metric system!

Speaking

8 **With a partner, act out the roles below, based on task 7. Then switch roles.**

USE LANGUAGE SUCH AS:

We need to talk about the measurements you're using.

There's plenty of time to fix it.

So that means we need ..., right?

Student A: You need to talk to a co-worker about measurements. Talk to Student B about:

- incorrect measurements
- correct measurements
- solution

Student B: You are an engineer. Answer Student A's questions.

Writing

9 **Use the email and the conversation from Task 8 to make a list of problems with the project.**

PROJECT Problems

Engineer 1 Name: _____

Engineer 2 Name: _____

Incorrect Measurements:

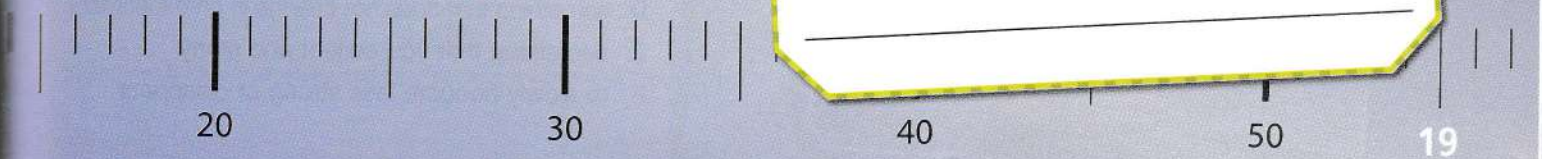
_____

_____

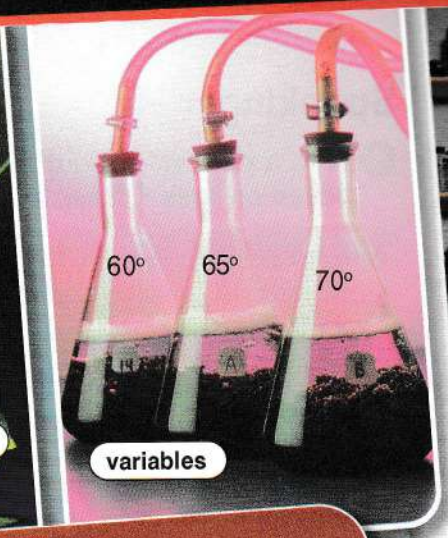
Correct Measurements:

_____

_____



9 The scientific method



PROJECT PROPOSAL FORM

Observation: Some computer cases **dissipate**, or lose, heat better than others.

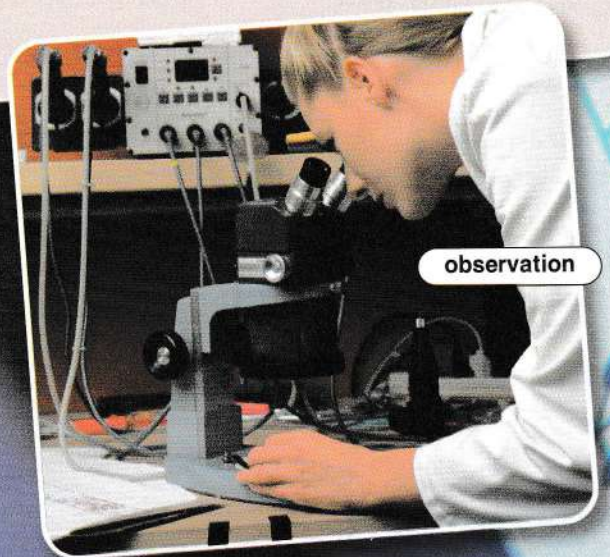
Problem: Why do they dissipate heat better?

Hypothesis: The cases contain different materials. Some of these materials hold heat in longer than others.

Experiment: We are checking how well different materials dissipate heat.

Methodology: We are testing glass and metal cups. They are our **variables**. A plastic cup serves as the **control**.

Procedure: Pour water into each cup. Heat the water to 60 degrees Celsius. Wait five minutes. Check the temperature of the water again and record the **data**. Analyze the data and present the **results**.



Get ready!

1 Before you read the passage, talk about these questions.

1 When do people use the scientific method?

2 Why is the scientific method important?

Reading

2 Read this proposal form from an engineer. Then, complete the table using information from the proposal.

Step	Details
Observation	Some computer cases _____
Hypothesis	Some computer case materials _____
Methodology	Variables: _____ Control: _____

Vocabulary

3 Match the words (1-6) with the definitions (A-F).

1 __ observation
2 __ data
3 __ variable
4 __ analyze
5 __ control
6 __ dissipate

A something that changes during an experiment
B a particular event or behavior that you witness
C to study something closely to learn more about it
D something that does not change in an experiment
E something that you collect and study
F to slowly become less strong or disappear

4 Choose the word that is closest in meaning to the underlined part.

1 Rob is performing a(n) scientific study.
A problem **B** experiment **C** control

2 Please explain your process.
A methodology **B** problem **C** hypothesis

3 What is your attempt to explain this observation?
A hypothesis **B** variable **C** experiment

4 Present the findings of your experiment.
A observations **B** hypotheses **C** results

5 All experiments begin with a question to answer.
A control **B** problem **C** methodology

5 Listen and read the proposal. What data will be recorded?

Listening

6 Listen to a conversation between an engineer and his manager. Mark the following statements as true (T) or false (F).

1 __ The manager doesn't understand the problem.
2 __ The manager suggests adding extra materials.
3 __ The engineer agrees to test rubber as a variable.

7 Listen again and complete the conversation.

Engineer: Hi Ms. Smith. Did you get a chance to review my **1** _____ _____?
Manager: Uh, yes. You want to study how different materials dissipate heat, right?
Engineer: Yes. It could really help us design better computer cases.
Manager: The problem and **2** _____ are clear. But I have a suggestion.
Engineer: Sure. What is it?
Manager: How **3** _____ _____ other materials as **4** _____? Maybe foam and rubber?
Engineer: Well, we know that rubber retains a lot of **5** _____.
Manager: **6** _____ _____. But try to think of some other materials to test.

Speaking

8 With a partner, act out the roles below, based on task 7. Then switch roles.

USE LANGUAGE SUCH AS:
Did you get a chance to ...?
It could really help ...
I have a suggestion.

Student A: You are submitting a proposal for an experiment. Talk to Student B about:
- the proposal form
- suggestions
- variables

Make up a name for your manager.

Student B: You are Student A's manager. Answer his or her questions.

Writing

9 Use the conversation from Task 8 to complete the manager's evaluation form.

PROJECT PROPOSAL EVALUATION FORM

Is problem clear? Y / N

Is hypothesis clear? Y / N

Suggestion for experiment:

_____

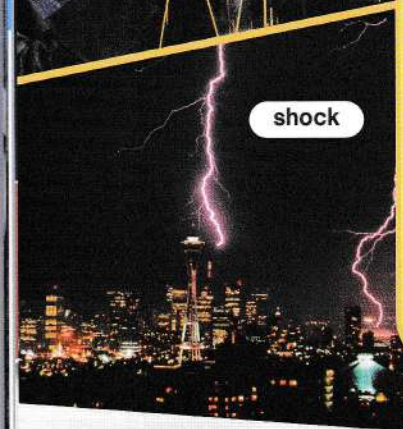
_____

_____

_____

_____

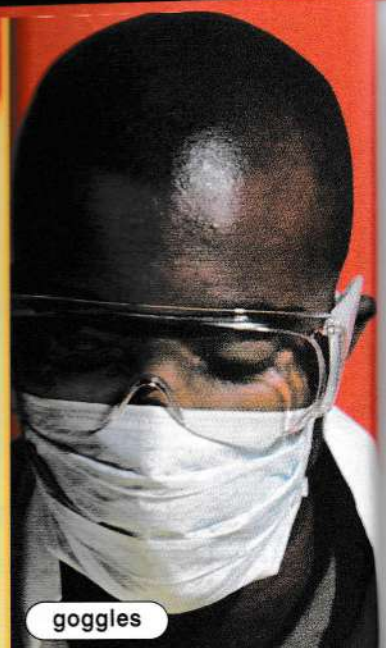
10 Safety precautions



READ THIS FIRST

The workplace is dangerous without proper care. Take the following **precautions** to prevent **accidents** and **injury**:

1. Report all potential **hazards** to a superior.
2. Always bring and wear safety gear like **gloves** and **goggles**.
3. Handle liquids carefully. Clean spills immediately to avoid slips.
4. Use caution when cleaning spills. Liquid on electrical equipment often causes **shock**.
5. Eating or drinking in the workplace is **prohibited**.
6. Only use the **fire extinguishers** to put out fires. Spraying water or other materials spreads flames and causes **burns**.
7. In case of injury, call paramedics. Treat minor wounds with **first aid**.



Get ready!

1 Before you read the passage, talk about these questions.

1. What are some ways to keep workplaces safe?
2. What should there be to ensure safety at work?

Reading

2 Read the workplace poster.

Then, choose the correct answers.

1. What is the poster about?
   - A first aid procedures
   - B safety in the workplace
   - C how to use a fire extinguisher
   - D where to find gloves and goggles

2. What should employees do when they see a hazard?
   - A wear safety gear
   - B call the paramedics
   - C tell a superior about it
   - D get a fire extinguisher

3. What can you infer about this workplace?
   - A Its fire extinguishers are new.
   - B Its employees eat while working.
   - C It provides safety for employees.
   - D It has potentially dangerous equipment.

Vocabulary

3 Match the words (1-6) with the definitions (A-F).

1. __ gloves
2. __ shock
3. __ goggles
4. __ burn
5. __ fire extinguisher
6. __ accident

- A puts out fires
- B an unwanted happening
- C protect your hands
- D injury caused by electricity
- E protect your eyes
- F injury caused by a fire

4 **Use the words from the word bank to fill in the blanks.**

WORD BANK

precaution hazard injury
prohibited first aid

1 Wearing goggles is a safety _____.
2 Sandals are _____ in the construction area.
3 Storing gas near open flames is a safety _____.
4 He only needs _____ because his wounds are minor.
5 The paramedics can treat the _____.

5 **Listen and read the poster. What can liquid on electrical equipment cause?**

Listening

6 **Listen to a conversation between a supervisor and an engineer. Mark the following statements as true (T) or false (F).**

1 __ The woman accidentally started a fire.
2 __ Charles was not wearing safety gear.
3 __ The man put out the fire.

7 **Listen again and complete the conversation.**

Supervisor: James, can I talk to you about the **1** _____ today?
Engineer: The **2** _____? Yes, of course.
Supervisor: So **3** _____ _____ happened?
Engineer: Well, Charles was using the blowtorch.
Supervisor: Was he wearing **4** _____ _____ _____?
Engineer: He was. But his hand slipped and something on the table started burning. He was trying to put it out when his shirt caught on fire.
Supervisor: OK, and then he **5** _____ _____ _____?
Engineer: Right. I got a fire extinguisher and **6** _____ _____ the fire.

Speaking

8 **With a partner, act out the roles below, based on task 7. Then switch roles.**

USE LANGUAGE SUCH AS:

I want to talk about the accident.
And then he slipped.
They're a hazard.

Student A: You are a supervisor. Ask Student B questions to find out about:

- an accident
- events
- safety precautions

Make up a name for your colleague.

Student B: You are an employee. Imagine an accident to answer Student A's questions.

Make up a name for your supervisor.

Writing

9 **Use the conversation from Task 8 to complete the supervisor's accident report (100-120 words). Write about:**

- what accident happened
- how it happened
- what happened to the people involved

gloves

11 Civil engineering

HOWARD & DAVIDSON
ENGINEERING

Job Title: **Civil Engineer**

Location: Dover, Kent, United Kingdom

Company: Howard & Davidson Engineering

Howard and Davidson Engineering is seeking a civil engineer. Applicants need experience designing many types of **infrastructure**. This includes:

- Small-**scale residential** and **commercial** projects. These serve individual clients.
- Large-scale **municipal** projects. These serve entire communities.

We work primarily with **land development** and **road construction** projects. As such, we need someone with knowledge of the related **water supply** issues. Experience with making **topographic** models is a plus. Knowledge of updated **construction** techniques is essential. We are looking to fill this position quickly.

Get ready!

1 Before you read the passage, talk about these questions.

1 What do civil engineers do?
2 How do civil engineers help cities?

Reading

2 Read this job posting. Then, choose the correct answers.

1 What is the posting mostly about?
- **A** a company's history
- **B** applicant qualifications
- **C** number of positions available
- **D** hiring civil engineering firms

2 What is the company NOT looking for?
- **A** knowledge of water supply issues
- **B** experience making topographic models
- **C** knowledge of new construction techniques
- **D** experience with large residential projects

3 What can be inferred about road construction projects?
- **A** They often have water supply issues.
- **B** They are included in residential projects.
- **C** They are used to create topographic models.
- **D** They take longer than land development.

Vocabulary

3 Check (✓) the sentence that uses the underlined part correctly.

1 ___ **A** Scale projects involve building bridges.
___ **B** Topographical models show areas' terrain.

2 ___ **A** Municipal projects serve communities.
___ **B** Construction projects fix water supplies.

3 ___ **A** Land development makes land more usable.
___ **B** Infrastructure projects develop maps of areas.

4 ___ **A** Civil Engineers create new types of aircraft.
___ **B** Commercial projects are related to business.

5 ___ **A** Residential projects construct homes.
___ **B** Road construction removes structures.

4 **Use the words from the word bank to fill in the blanks.**

WORD BANK

water supply infrastructure
civil engineer scale
road construction

1 Jennifer wants to be a(n) _____.
2 Bridges are part of a city's _____.
3 A dirty _____ can harm thousands of people.
4 _____ often causes traffic to back up.
5 The _____ of this project is larger than the last one.

5 **Listen and read the job posting. What experience and knowledge should the successful applicant have?**

Listening

6 **Listen to a conversation between an employer and a job candidate. Mark the following statements as true (T) or false (F).**

1 __ The employer decides to hire the candidate.
2 __ The man is working on a housing development.
3 __ Design Co works with municipal projects.

7 **Listen again and complete the conversation.**

Employer: So, where are you working now?
Candidate: I'm a **1** _____ _____ with Design Co.
Employer: I see. What types of **2** _____ do you do there?
Candidate: Mostly **3** _____ _____.
Employer: Okay. What are you **4** _____ _____ right now?
Candidate: Well, right now I'm working on a new housing **5** _____.
Employer: Great. We work on those fairly often. Why do you want to leave your company?
Candidate: I'd like to do some **6** _____ design projects. But Design Co doesn't do them.

Speaking

8 **With a partner, act out the roles below, based on task 7. Then switch roles.**

USE LANGUAGE SUCH AS:

What types of projects do you do there?
Why do you want to leave your company?
I'd like to do some ... projects.

Student A: You are interviewing a job candidate. Talk to Student B about:

- experience
- current projects
- reasons for leaving

Student B: You are a job candidate. Answer Student A's questions.

Writing

9 **Use the job posting and the conversation from Task 8 to write notes about the job interview you conducted. Make up a name for the candidate.**

JOB INTERVIEW NOTES

Employer Name: _____

Job Candidate Name: _____

Experience: _____

_____

Current Projects: _____

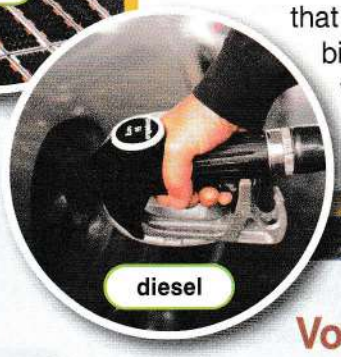
_____

_____

_____

_____

12 Chemical engineering



IMPROVING bio DIESEL

Gary Flanders, a **chemical engineer**, is changing how the country uses **fuel**. Most of the country uses **fossil fuels** for energy. Gary is making breakthroughs with **alternative fuel**.

He's starting with **diesel**, which powers buses and trucks. He's working on a new fuel called **biodiesel**. Because it comes from plants instead of **petroleum**, it's completely **biodegradable** and **non-toxic**. It is also 100% **renewable**.

But some people don't like biodiesel. They say that it requires too much farmland. And creating additional farmlands would destroy animal habitats. Critics are also worried that farmers would grow crops for biodiesel instead of food. This would cause food shortages.

Get ready!

1 Before you read the passage, talk about these questions.

1 What is chemical engineering?
2 How does chemical engineering affect the world?

Reading

2 Read this newspaper article about chemical engineering. Then, choose the correct answers.

1 What is the article about?
- **A** how biofuel damages farms
- **B** the damage caused by fossil fuels
- **C** the types of work chemical engineers do
- **D** the risks and benefits of an alternative fuel

2 What can you infer from the article?
- **A** Biodiesel works in any vehicle.
- **B** Biodiesel is as poisonous as fossil fuels.
- **C** Crop shortages slow the spread of biodiesel.
- **D** People use alternative fuels less than fossil fuels.

3 Which of the following is NOT true?
- **A** Biodiesel breaks down naturally.
- **B** Biodiesel has a renewable source.
- **C** Biodiesel requires a lot of farmland.
- **D** Biodiesel contaminates animal habitats.

Vocabulary

3 Match the words (1-7) with the definitions (A-G).

1 __ diesel
2 __ chemical engineer
3 __ petroleum
4 __ biodiesel
5 __ renewable
6 __ fossil fuel
7 __ non toxic

- **A** energy source made from vegetable oils or animal fat
- **B** not poisonous
- **C** a type of oil
- **D** energy source like coal and oil
- **E** able to be replaced
- **F** fuel used in big engines
- **G** someone who works in the chemical industry

4 **Use the words from the word bank to fill in the blanks.**

WORD BANK

biodegradable fuel
alternative fuel

1 Switch to a(n) _____, like biodiesel.
2 _____ materials break down quickly.
3 Most cars today use gasoline for _____.

5 **Listen and read the article. Why are some people against biodiesel?**

Listening

6 **Listen to a conversation between a chemical engineer and a reporter. Mark the following statements as true (T) or false (F).**

1 __ The engineer admits that biodiesel has risks.
2 __ Biodiesel can be made from non-food crops.
3 __ Algae has failed as a source of biodiesel.

7 **Listen again and complete the conversation.**

Reporter: So what do you think about the **1** _____ of biodiesel?
Engineer: What do you mean?
Reporter: Many critics say that **2** _____ will cause a food shortage.
Engineer: I **3** _____. There are enough crops in the world to supply both food and fuel.
Reporter: But as the population grows, **4** _____ for both will increase.
Engineer: That's why we're starting to make biodiesel from **5** _____-_____ _____.
Reporter: Really? What crops are you using?
Engineer: Well, we've had **6** _____ _____ _____ _____ making biodiesel from algae.

Speaking

8 **With a partner, act out the roles below, based on task 7. Then switch roles.**

USE LANGUAGE SUCH AS:

What do you think about ...
There are enough ...
What crops are you using?

Student A: You are a reporter. Ask Student B questions to find out about:

- risks of biodiesel
- food shortages
- non-food crops

Student B: You are a chemical engineer. Answer Student A's questions about biodiesel.

Writing

9 **Use the newspaper article and the conversation from Task 8 to complete the reporter's notes.**

Interview with: _____

About: _____

_____

Engineer's thoughts on risks: _____

_____

Alternatives: _____

Having success with: _____

_____

_____

_____

_____

_____

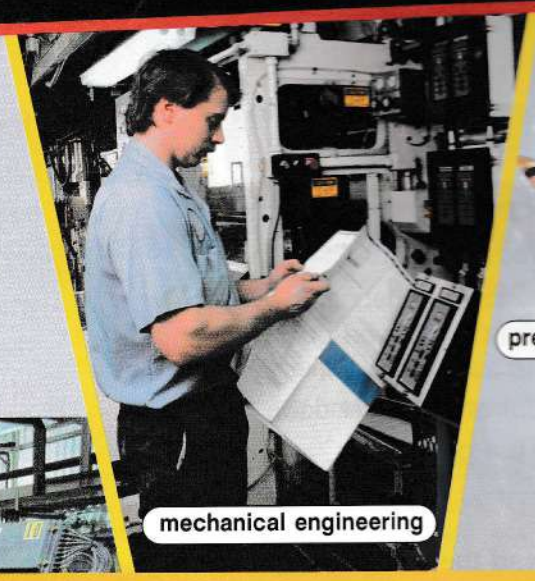
13 Mechanical engineering

Get ready!

1 Before you read the passage, talk about these questions.

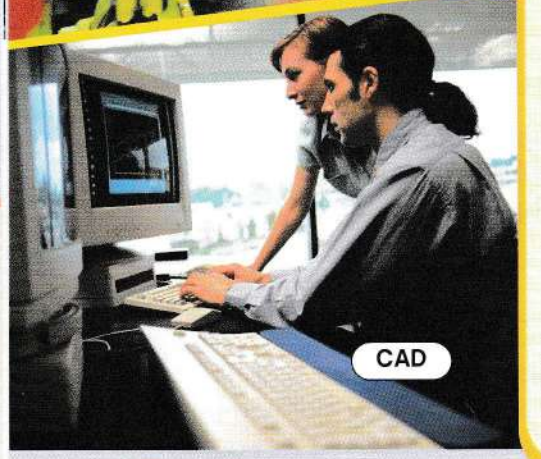
1 What types of problems do mechanical engineers fix?

2 What kinds of computer methods do mechanical engineers use?


mechanical engineering


pressure vessel


CAM


CAD


drafting

SHARP & CO.

http://sharp&co.com.uk

At Sharp & Co., we specialize in designing and building **pressure vessels**. We offer many kinds of services. These include:

Creating a physical **prototype** of systems in the design phase
Creating virtual models of systems with **CAD** (computer-aided design)
Testing conditions with **CFD** (computational fluid dynamics) **simulations**
Drafting of the **mechanism**
Building parts to specifications using **CAM** (computer-aided manufacturing)
Studying and testing of **stresses**

Building a pressure vessel system requires expert skill and knowledge. Let our **mechanical engineering** team help build your system today. Please call or email us for more details.

Reading

2 Read this page from the website of a mechanical engineering firm. Then, read the summary of the passage. Fill in the blanks using words from the word bank.

word BANK

CAD stresses services
prototypes CAM pressure

Sharp and Co. is a company that designs and builds 1 _____ vessels. The company offers a variety of 2 _____. Its engineers make physical 3 _____ of systems. And they also make virtual models of systems using 4 _____. They build the parts of the pressure vessel using 5 _____. They also test for 6 _____.

Vocabulary

3 Match the words (1-5) with the definitions (A-E).

1 __ CFD
2 __ pressure vessel
3 __ CAD
4 __ stress
5 __ CAM

A a container that holds liquid or gas
B the use of computer technology to build machines
C the use of formulas to study how fluids and gases move
D using technology to create computer models
E a force that presses against an object

4 Write the word that is similar in meaning to the underlined part.

1 Imitations of possible events test for weaknesses. s _ _ u _ _ t _ _ n _
2 Engineers take courses in the process of creating drawings. d _ a _ t _ _ g
3 One broken part of a larger system causes the machine to fail. m _ _ h _ _ i _ m
4 The initial model of the machine will be finished soon. _ r _ _ o _ y _ e
5 The design and construction of machines is a growing field.
_ _ c _ a _ _ c _ l e _ g _ _ e _ r _ _ g

5 Listen and read the website. How can you get more information on Sharp & Co's services?

Listening

6 Listen to a conversation between a customer and an employee of Sharp & Co. Mark the following statements as true (T) or false (F).

1 __ The customer needs a pressure vessel for gas.
2 __ A physical prototype is faster than a computer model.
3 __ The customer chooses the physical prototype.

7 Listen again and complete the conversation.

Employee: Sharp and Company. How can I help you?
Customer: Hi. I need a custom **1** _____ _____ for a gas line.
Employee: Um, we can build a physical **2** _____ or we can work with a computer model.
Customer: Hmm. What would you recommend?
Employee: Well, **3** _____ _____ are faster. And they let us perform a lot of simulations.
Customer: But you also test physical prototypes, **4** _____?
Employee: Yes. But obviously, you can **5** _____ _____ _____ _____ with a computer model.
Customer: Okay. Let's **6** _____ _____ that.

Speaking

8 With a partner, act out the roles below, based on task 7. Then switch roles.

USE LANGUAGE SUCH AS:

I need a custom pressure vessel.
We can ... or we can ...
What would you recommend?

Student A: You need a pressure vessel. Talk to Student B about:

- types of models
- recommendations
- testing prototypes

Student B: You work at an engineering firm. Answer Student A's questions.

Writing

9 You are an engineer. Use the conversation from Task 8 to complete the order form. Write about:

- what the customer ordered
- what questions he/she had
- what you explained to them

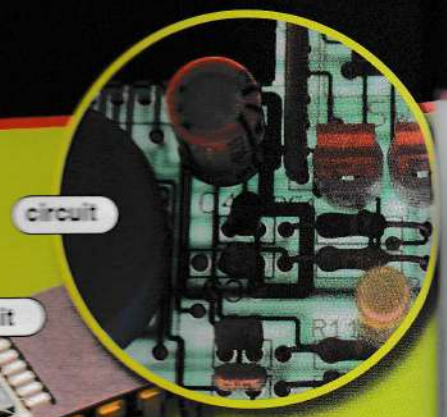
SHARP AND CO.
ORDER FORM

Customer Request:
_____

Customer Order:
_____

Notes:
_____
_____

14 Electrical engineering

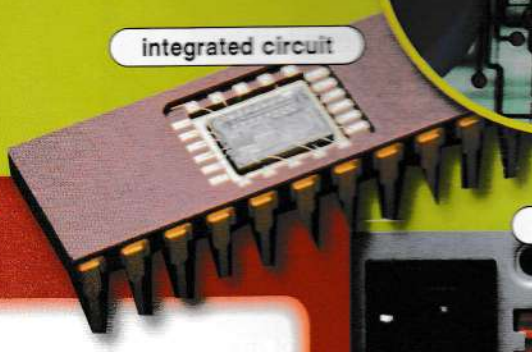


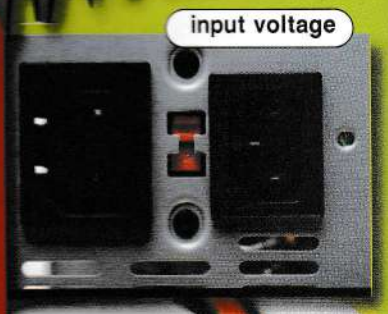
Get ready!

1 Before you read the passage, talk about these questions.

1 What is electrical engineering?

2 What products do electrical engineers make?





From: Ted Everett <teverett@elecco.com>
To: Brian Smith <bsmith@elecco.com>
Subject: Deadline Changes

Brian,
The deadline for the model GR-7 DVD player project is next month. As a result, we're delaying production on the GR-2.2 model. We need to adjust our production of some **components**.

Fortunately, both models use many of the same parts. Keep making **circuit card assemblies** for both. However, the models use different **power supplies**. Stop all production of GR-2.2 power supplies and focus on creating GR-7 power supplies.

Remember to make the necessary adjustments. The GR-7 power supplies require an **input voltage** of 120 **volts** and an **output voltage** of 5 volts. These are slightly higher than the settings for the GR-2.2 power supplies. Remember the **output power**, too. The GR-7 power supplies must produce 27 **watts** – the GR-2.2 only produce 24 watts.

Please inform the rest of the staff of the change.
Ted Everett
Electrical Engineering Supervisor

Reading

2 Read this e-mail from a supervisor. Then, choose the correct answers.

1 What is the e-mail about?

A changing production orders
B canceling GR-7 production
C using GR-7 components in the GR-2.2
D the difference between input and output voltage

2 Which of the following is NOT true?

A The GR-2.2 and GR-7 use the same power supply.
B The circuit card assemblies can be used in both models.
C The GR-2.2 has a lower input voltage than the GR-7.
D The GR-7 has a greater output power than the GR-2.2.

3 What can you infer about the company?

A It has over 120 employees.
B Its DVD players have incorrect output voltages.
C It has different deadlines for different models.
D It purchases power sources from manufacturers.

Vocabulary

3 Match the words (1-4) with the definitions (A-D).

1 __ volt
2 __ output voltage
3 __ watt
4 __ output power

A measure of electrical power
B measure of electrical potential
C voltage put out by a device
D watts put out by a device

4 **Use the words from the word bank to fill in the blanks.**

WORD BANK

input voltage
power supply components

1 The _____ directs electricity to the disk drive.
2 This TV needs a minimum _____ to work.
3 The factory assembles the different _____.

5 **Listen and read the email. How much more power than the GR-2.2s do the GR-7 power supplies produce?**

Listening

6 **Listen to a conversation between a manager and an engineer. Mark the following statements as true (T) or false (F).**

1 __ The man decides not to change the deadline.
2 __ The company will stop production of all GR-2.2 parts.
3 __ The woman is creating a new power supply.

7 **Listen again and complete the conversation.**

Manager: Valerie, can I talk to you for a moment?
Engineer: Of course, Mr. Smith. What's up?
Manager: We're changing the **1** _____ on the GR-7 and GR 2.2 DVD player projects.
Engineer: Really? Aren't we trying to finish both at the same time?
Manager: The GR-7 **2** _____ are due next month. So we're **3** _____ _____ GR-2.2s.
Engineer: Okay. I'll stop production on all GR-2.2 **4** _____.
Manager: No, don't do that. The same **5** _____ _____ _____ work in both products.
Engineer: Oh, that's right. We just need to hold off on GR-2.2 **6** _____ _____, then.

Speaking

8 **With a partner, act out the roles below, based on task 7. Then switch roles.**

USE LANGUAGE SUCH AS:

We're changing the deadlines.
We're pushing back ...
The same ... work in both products.

Student A: You are a manager. Your company is changing the deadline of a project. Talk to Student B about:

- what is due sooner
- what to stop making
- what to keep making

Make up a name for the engineer.

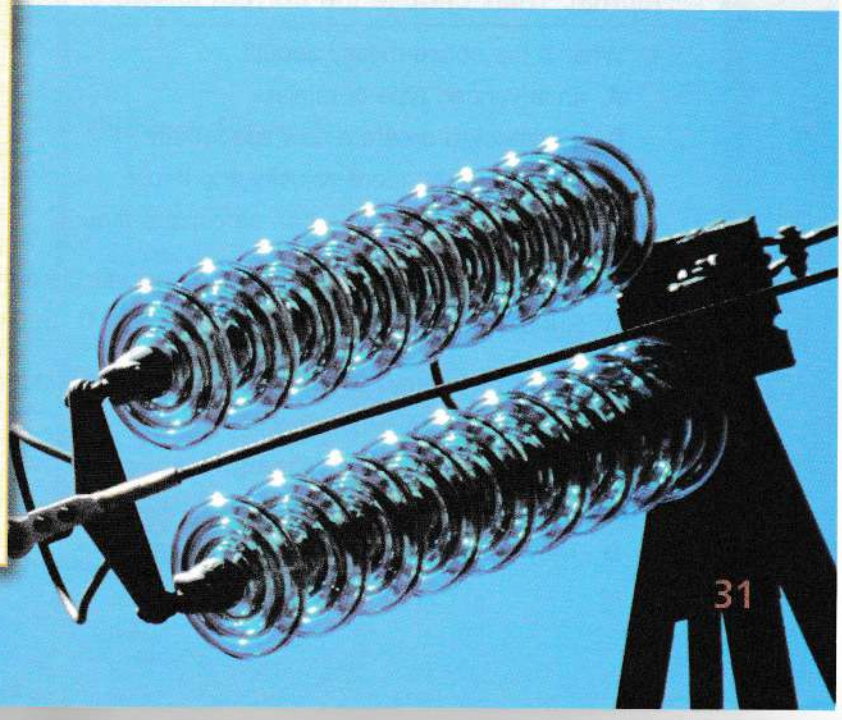
Student B: You are an engineer. Talk to Student A about changing the deadline.

Make up a name for the manager.

Writing

9 **You are an engineer. Use the conversation from Task 8 to write an e-mail (100-120 words). Write about:**

- what deadlines are changing
- what things should still be made
- what things they should stop making



15 Aerospace engineering

THE TOMORROW'S TECH CHALLENGE IS HERE!

The Tomorrow's Tech Foundation is offering a large **licensed production** payment for its fourth annual challenge. The goal is to design a new **spacecraft**. The design is mostly wide-open, but there are some requirements and restrictions. It must meet the following requirements:

- capability to **launch** up to 6,000 pound payload
- an **internal fuel capacity** of at least 5,000 pounds
- at least 16,000 pounds of **thrust**
- a minimum **velocity** of **Mach** 2.5

All types of **propellant** are acceptable. Obviously, designs featuring **ramjets** will not be accepted.

500 million euros is the maximum **flyaway value** for this project. Go to our website to register your design team. Good luck!

Get ready!

1 Before you read the passage, talk about these questions.

1 What kinds of aircraft have you been on?
2 How has aerospace engineering changed travel?

Reading

2 Read this notice from an aerospace engineering journal. Then, choose the correct answers.

1 What is the notice mostly about?
- **A** an advanced type of ramjet
- **B** a contest to create a new spacecraft
- **C** the way to get more velocity and thrust
- **D** a job announcement for an aerospace firm

2 How many pounds of thrust must the new vehicle achieve?
A 5,000 **B** 6,000 **C** 16,000 **D** 500 million

3 What can be inferred about Tomorrow's Tech Foundation?
- **A** They specialize in ramjet design.
- **B** They own four space vehicles.
- **C** They offer challenges every year.
- **D** They specialize in fuel efficient aircraft.

Vocabulary

3 Match the words (1-6) with the definitions (A-F).

1 __ propellant
2 __ launch
3 __ velocity
4 __ Mach
5 __ thrust
6 __ licensed production

- **A** a measurement of speed based on comparisons to the speed of sound
- **B** the fuel used in the engines of flying vehicles
- **C** to send something upwards
- **D** a measurement of how far something travels in a set amount of time
- **E** the force exerted by an engine
- **F** paying a company for the right to use its design

4 Write a word that is similar in meaning to the underlined part.

1 The <u>amount of fuel carried inside</u> of this jet is 7,000 pounds.
i _ _ _ r _ _ _ f _ _ l c _ _ _ c _ _ y

2 Few people have been on <u>vehicles that fly beyond Earth's atmosphere</u>.
s _ _ _ _ c _ _ f _

3 An <u>engine that compresses air</u> can reach very high speeds.
_ _ m _ e _

4 What is the <u>cost of getting a vehicle to fly</u>?
_ _ y _ _ _ y _ _ l _ e

5 Listen and read the notice. Why will designs featuring ramjets not be accepted?

Listening

6 Listen to a conversation between an engineer and a Tomorrow's Tech receptionist. Mark the following statements as true (T) or false (F).

1 __ The contest allows all types of propellant.
2 __ The engineer asks about velocity.
3 __ The spacecraft must reach Mach 3.5

7 Listen again and complete the conversation.

Receptionist: Tomorrow's Tech. Can I help you?
Engineer: Hi. I'm calling about the **1** _____ _____.
Receptionist: Okay. **2** _____ _____ _____ to register a design team?
Engineer: I think so. But I have a few questions first. The design can use any type of **3** _____, right?
Receptionist: Yes, that's right.
Engineer: And it has to reach a **4** _____ _____ _____ _____ _____?
Receptionist: No, it **5** _____ _____ to reach 2.5
Engineer: Oh, I see. That **6** _____ _____ easier.

Speaking

8 With a partner, act out the roles below, based on task 7. Then switch roles.

USE LANGUAGE SUCH AS:

I'm calling about the ...
The design can use ...
No. It only needs to ...

Student A: You are interested in a spacecraft challenge. Ask Student B questions about:

- the contest
- propellant
- velocity

Student B: You work for the contest organizer. Answer Student A's questions.

Writing

9 Use the conversation from Task 8 to write a note about the aircraft challenge.

TOMORROW'S TECH CHALLENGE

Challenge Requirements:

_____
_____
_____

Challenge Allows:

_____
_____
_____
_____
_____

Glossary

abstract [N-COUNT-U5] An **abstract** is a summary of an article, document, or other text.

accident [N-COUNT-U10] An **accident** is something bad that was not meant to happen.

alternative fuel [N-COUNT-U12] An **alternative fuel** is a substance that is used for energy instead of fossil fuels.

arch [N-COUNT-U2] An **arch** is a semicircle shape over an entrance.

architect [N-COUNT-U2] An **architect** is a person whose job is to design and build structures.

biodegradable [ADJ-U12] If something is **biodegradable**, it will break apart naturally.

biodiesel [N-UNCOUNT-U12] **Biodiesel** is fuel that is made from vegetable oils or animal fat.

burn [N-COUNT-U10] A **burn** is damage caused by heat or fire.

CAD [N-UNCOUNT-U13] **CAD** (computer-aided design) refers to using computer technology to create computer models of objects.

CAM [N-UNCOUNT-U13] **CAM** (computer-aided manufacturing) refers to the use of computer technology to help build the parts of a machine.

centimeter [N-COUNT-U8] A **centimeter** is a metric measurement of distance that is equal to one one-hundredth of a meter.

ceramic [N-UNCOUNT-U3] **Ceramic** is a solid material made from clay or similar materials.

CFD [N-UNCOUNT-U13] **CFD** (computational fluid dynamics) refers to the use of mathematical formulas to study problems related to the movement of fluids and gases.

chemical engineer [N-COUNT-U12] A **chemical engineer** is someone who works in the chemical industry.

circuit card assembly [N-COUNT-U14] A **circuit card assembly** is a card with all components installed that can be used to perform a variety of tasks in electrical equipment.

civil engineer [N-COUNT-U11] A **civil engineer** is a person who works with the design and construction of the physical environment. This includes buildings, roads, bridges, and other things.

clip [V-TRANS-U4] To **clip** something is to cut off part of it.

coated [ADJ-U3] If something is **coated**, it is covered by some type of material.

commercial [ADJ-U11] Something that is **commercial** is related to business or commerce.

complicated [ADJ-U6] If something is **complicated**, it has many details or is hard to understand.

component [N-COUNT-U14] A **component** is a part of something bigger.

concrete [N-UNCOUNT-U3] **Concrete** is a construction material made out of cement, crushed rocks, and other materials.

construction [N-UNCOUNT-U11] **Construction** is the process of building structures such as buildings, roads, and bridges.

control [N-COUNT-U9] A **control** is a situation or condition that you do not change during an experiment.

convert [V-TRANS-U12] To **convert** something is to change it from one thing to another.

cubed [ADJ-U7] If a number is **cubed**, it is to be multiplied by itself three times.

cylinder [N-COUNT-U2] A **cylinder** is a shape with long, straight sides and two circular ends.

data [N-UNCOUNT-U9] **Data** are numbers or characteristics that you collect and study.

decelerate [V-T-U5] To **decelerate** is to slow down.

design [V-T-U1] To **design** something is to plan how it will look and how it will function.

develop [V-T-U1] To **develop** something is to create it or to cause it to grow or expand.

diesel [N-UNCOUNT-U12] **Diesel** is a fuel that is used in big engines like buses and trucks.

discipline [N-COUNT-U1] A **discipline** is a branch of instruction or learning.

drafting [N-UNCOUNT-U13] **Drafting** refers to the process of creating engineering drawings for machines. They illustrate how to manufacture and assemble the parts.

drill [N-COUNT-U4] A **drill** is a tool that makes holes in surfaces like wood or inserts and removes screws.

ellipse [N-COUNT-U2] An **ellipse** is a shape like a flat circle or oval.

engineer [N-COUNT-U1] An **engineer** is a person who uses the knowledge gained by science to design and create practical applications for it.

engineering [N-UNCOUNT-U1] **Engineering** is the art of designing and creating practical applications from the knowledge gained by science.

equal [V-T-U7] To **equal** something is to be the same as that thing.

experiment [N-COUNT-U9] An **experiment** is a scientific study that you conduct to solve a problem.

exponent [N-COUNT-U7] An **exponent** is a small number written above another number and which signifies how many times the bottom number should be multiplied by itself.

fire extinguisher [N-COUNT-U10] A **fire extinguisher** is a device used to put out fires.

first aid [N-UNCOUNT-U10] **First aid** is fast, basic medical treatment given right after an injury.

flyaway value [N-COUNT-U15] The **flyaway value** of a vehicle that flies through the air is the total cost involved in making it and having it fly.

foot [N-COUNT-U8] A **foot** is an imperial measurement of distance that is equal to twelve inches.

force [N-COUNT-U5] A **force** is something that causes an object to move.

fossil fuel [N-COUNT-U12] **Fossil fuel** is an energy source that is made from organic remains. Coal, gas and oil are fossil fuels.

fuel [N-COUNT-U12] A **fuel** is a substance that provides energy when burned.

fulcrum [N-COUNT-U6] A **fulcrum** is the pointed support that a lever's board or bar rests upon.

G [N-COUNT-U5] A **G** is a unit of force that is equal to the force of gravity. It is used to show the forces on an object when it accelerates.

gallon [N-COUNT-U8] A **gallon** is an imperial measurement of volume that is equal to approximately five liters.

Glossary

geometric [ADJ-U2] Something that is **geometric** relates to the study of shapes and other figures.

glass [N-UNCOUNT-U3] **Glass** is a solid, transparent material commonly used in windows.

gloves [N-UNCOUNT-U10] **Gloves** are protective clothes worn over the hands.

goggles [N-UNCOUNT-U10] **Goggles** are eye glasses that provide protection.

hazard [N-COUNT-U10] A **hazard** is something known to be dangerous.

hundredth [N-COUNT-U7] A **hundredth** is one of one hundred equal things.

hypothesis [N-COUNT-U9] A **hypothesis** is an idea that attempts to explain an observation.

imperial [ADJ-U8] Something that is **imperial** is part of the system of measurements that is uncommon in most parts of the world. It includes measurements such as the gallon, foot, and pound.

inch [N-COUNT-U8] An **inch** is an imperial measurement of distance that is equal to one twelfth of a foot.

inclined plane [N-COUNT-U6] An **inclined plane** is a smooth surface with one end that is higher than the other.

infrastructure [N-UNCOUNT-U11] **Infrastructure** is the physical structures needed to operate a society or an organization.

injury [N-COUNT-U10] An **injury** is damage to the body.

input voltage [N-COUNT-U14] **Input voltage** is the number of volts a device needs to operate.

inspect [V-T-U1] To **inspect** something is to examine it carefully.

internal fuel capacity [N-COUNT-U15] **Internal fuel capacity** is the maximum amount of fuel a vehicle can carry without externally attached fuel tanks.

kilogram [N-COUNT-U8] A **kilogram** is a metric measurement of weight that is equal to one thousand grams. It is also equal to approximately two pounds.

kinetic energy [N-UNCOUNT-U5] The **kinetic energy** of an object is the energy it possesses due to motion. It is gained through acceleration and stays constant unless the object's speed changes.

land development [N-UNCOUNT-U11] **Land development** is the process of making an area of land more useful by constructing buildings, roads, or bridges.

launch [V-T/I-U15] To **launch** something is to push it into the air very quickly.

lever [N-COUNT-U6] A **lever** is a bar that rests on a fulcrum.

leverage [N-UNCOUNT-U6] **Leverage** is the power that comes from using a lever.

licensed production [N-UNCOUNT-U15] **Licensed production** is the practice of paying a company for the right to produce something it has designed.

liter [N-COUNT-U8] A **liter** is a metric measurement of volume that is equal to one thousand milliliters. It is also equal to approximately one fifth of a gallon.

load [N-COUNT-U6] A **load** is a particular amount of weight a person or machine lifts or carries.

lumber [N-UNCOUNT-U3] **Lumber** is wood that is used as a construction material.

Mach [N-UNCOUNT-U15] **Mach** is a unit for measuring the speed of something in comparison to the speed of sound.

machine [N-COUNT-U1] A **machine** is an apparatus made from multiple parts. It is designed to perform some kind of work.

mathematics [N-UNCOUNT-U1] **Mathematics** is the study of numbers and change.

mechanical engineering [N-UNCOUNT-U13] **Mechanical engineering** is concerned with designing, making and using machines and tools.

mechanism [N-COUNT-U13] A **mechanism** is a number of parts in a machine that are linked together to perform a particular task.

meter [N-COUNT-U8] A **meter** is a metric measurement of distance that is equal to one hundred centimeters.

methodology [N-COUNT-U9] A **methodology** is a particular way of studying or doing something.

metric [ADJ-U8] Something that is **metric** is part of the system of measurements used throughout most of the world. It includes measurements such as the liter, meter, and gram.

municipal [ADJ-U11] Something that is **municipal** is related to an entire city, town, or community.

nontoxic [ADJ-U12] If something is **nontoxic**, it is not poisonous.

observation [N-COUNT-U9] An **observation** is a particular behavior or event that you witness.

output power [N-COUNT-U14] **Output power** is the amount of watts a power source puts out.

output voltage [N-COUNT-U14] **Output voltage** is the number of volts a power source puts out.

oval [N-COUNT-U2] An **oval** is a round shape that is longer than it is wide.

percent [N-UNCOUNT-U7] A **percent** is a number out of every 100.

petroleum [N-UNCOUNT-U12] **Petroleum** is a type of oil found in the ground.

physics [N-UNCOUNT-U1] **Physics** is a part of science that deals with the study of matter, movement, energy, and force.

pliers [N-UNCOUNT-U4] **Pliers** are tools that are used to pull out nails or cut wires.

porcelain [N-UNCOUNT-U3] **Porcelain** is a solid ceramic material that is of higher quality than normal ceramic.

potential energy [N-UNCOUNT-U5] The **potential energy** of an object is the potential that it has due to its position. It becomes kinetic energy when the object begins moving.

pound [N-COUNT-U8] A **pound** is an imperial measurement of weight that is equal to approximately 454 grams.

power supply [N-COUNT-U14] A **power supply** distributes electrical current to a device.

precaution [N-COUNT-U10] A **precaution** is something you do to prevent something from happening.

pressure vessel [N-COUNT-U13] A **pressure vessel** is a container that holds liquid or gas at a specific pressure.

prism [N-COUNT-U2] A **prism** is a three-dimensional shape.

problem [N-COUNT-U9] A **problem** is a question that you are trying to answer.

procedure [N-COUNT-U9] A **procedure** is a series of steps that one takes during an experiment.

Glossary

prohibited [ADJ-U10] If something is **prohibited**, it is not allowed.

propellant [N-COUNT-U15] **Propellant** is the fuel used in the engine of a vehicle that flies through the air.

prototype [N-COUNT-U13] A **prototype** is an initial model of a machine or system. Engineers use this to help build the actual machine.

pulley [N-COUNT-U6] A **pulley** is a machine that consists of a wheel with a rope in its groove.

ramjet [N-COUNT-U15] A **ramjet** is an engine, for a vehicle that flies through the air, that has no rotating parts.

rectangle [N-COUNT-U2] A **rectangle** is a shape consisting of four straight lines and four right angles, and whose opposite sides are the same length.

reinforced [ADJ-U3] If something is **reinforced**, it is made stronger by the addition of some type of material.

renewable [ADJ-U12] If a resource is **renewable**, it can be replaced by the natural world.

residential [ADJ-U11] Something that is **residential** is related to where people live.

result [N-COUNT-U9] A **result** is a finding or conclusion of an experiment.

road construction [N-UNCOUNT-U11] **Road construction** is the process of building a road.

scale [N-UNCOUNT-U11] **Scale** is the size of something in comparison to another similar thing.

screw [N-COUNT-U4] A **screw** is a piece of metal that you turn to fasten objects together.

screwdriver [N-COUNT-U4] A **screwdriver** is a tool for putting screws into surfaces.

semi-circle [N-COUNT-U2] A **semi-circle** is a shape that is half of a circle.

shock [N-COUNT-U10] A **shock** is an injury caused by electricity.

simple machine [N-COUNT-U6] A **simple machine** is a basic machine with few moving parts.

simulation [N-COUNT-U13] A **simulation** is an imitation of a possible event or situation.

solder [N-UNCOUNT-U4] **Solder** is a soft metal wire that is heated with a soldering iron to join two metal surfaces.

soldering iron [N-COUNT-U4] A **soldering iron** is used to join pieces of metal together with solder.

spacecraft [N-COUNT-U15] A **spacecraft** is a vehicle that flies outside the Earth's atmosphere.

square [N-COUNT-U2] A **square** is a shape consisting of four right angles and four straight sides of equal length.

squared [ADJ-U7] If a number is **squared**, it is to be multiplied by itself.

stainless steel [N-UNCOUNT-U3] **Stainless steel** is a type of steel that does not rust.

steel [N-UNCOUNT-U3] **Steel** is a very strong construction material that is made mostly from iron.

stopping distance [N-COUNT-U5] A **stopping distance** is the distance an object in motion takes to come to a complete stop.

stress [N-COUNT-U13] A **stress** is a force that presses against an object. It can cause the object to change shape.

strip [V-TRANS-U4] To **strip** something is to remove it from the surface of something else.

technology [N-UNCOUNT-U1] **Technology** is the group of new and sophisticated creations which make our lives easier. Examples include television, computers, and telephones.

tenth [N-COUNT-U7] A **tenth** is one of ten equal things.

textured [ADJ-U3] If something is **textured**, it has specific qualities added to its surface.

thousandth [N-COUNT-U7] A **thousandth** is one of one thousand equal things.

thrust [N-UNCOUNT-U15] **Thrust** is the force exerted by an engine that causes a vehicle to fly through the air.

tile [N-COUNT-U3] A **tile** is a construction material that is made from ceramic, porcelain, stone, and other materials. It is often used as a wall or floor covering.

times [PREP-U7] If something is **times** a number, it is multiplied by that number.

to the (-th) power [PHRASE-U7] If something is multiplied **to the (-th) power**, it is multiplied by itself that number of times.

topographic [ADJ-U11] Something that is **topographic** is related to the detailed mapping of terrain.

transfer [V-I-U5] To **transfer** something is to move it from one object to another.

variable [N-COUNT-U9] A **variable** is a situation or condition that you change during an experiment.

vault [N-COUNT-U2] A **vault** is a rounded or triangular space added to a ceiling to create space.

velocity [N-UNCOUNT-U15] **Velocity** is a measurement of how far something travels in a set amount of time.

vise [N-COUNT-U4] A **vise** holds something tightly in place while someone works on it.

volt [N-COUNT-U14] A **volt** is a measurement of electric potential.

water supply [N-UNCOUNT-U11] The **water supply** is the supply of fresh water for an area or community.

watt [N-COUNT-U14] A **watt** is a measurement of electrical power.

wedge [N-COUNT-U6] A **wedge** is a tool with one wide end and one pointed end.

wheel and axle [N-COUNT-U6] A **wheel and axle** is a machine consisting of a wheel with a rod through it.

wire stripper [N-COUNT-U4] A **wire stripper** is a tool that is used to remove insulation from wires.

work [N-UNCOUNT-U5] **Work** is the transfer of energy. It is measured by how far an object is moved by a force.

work-energy principle [N-UNCOUNT-U5] The **work-energy principle** is the idea that the change in an object's energy is equal to the total work done to the object.

CAREER PATHS

Engineering

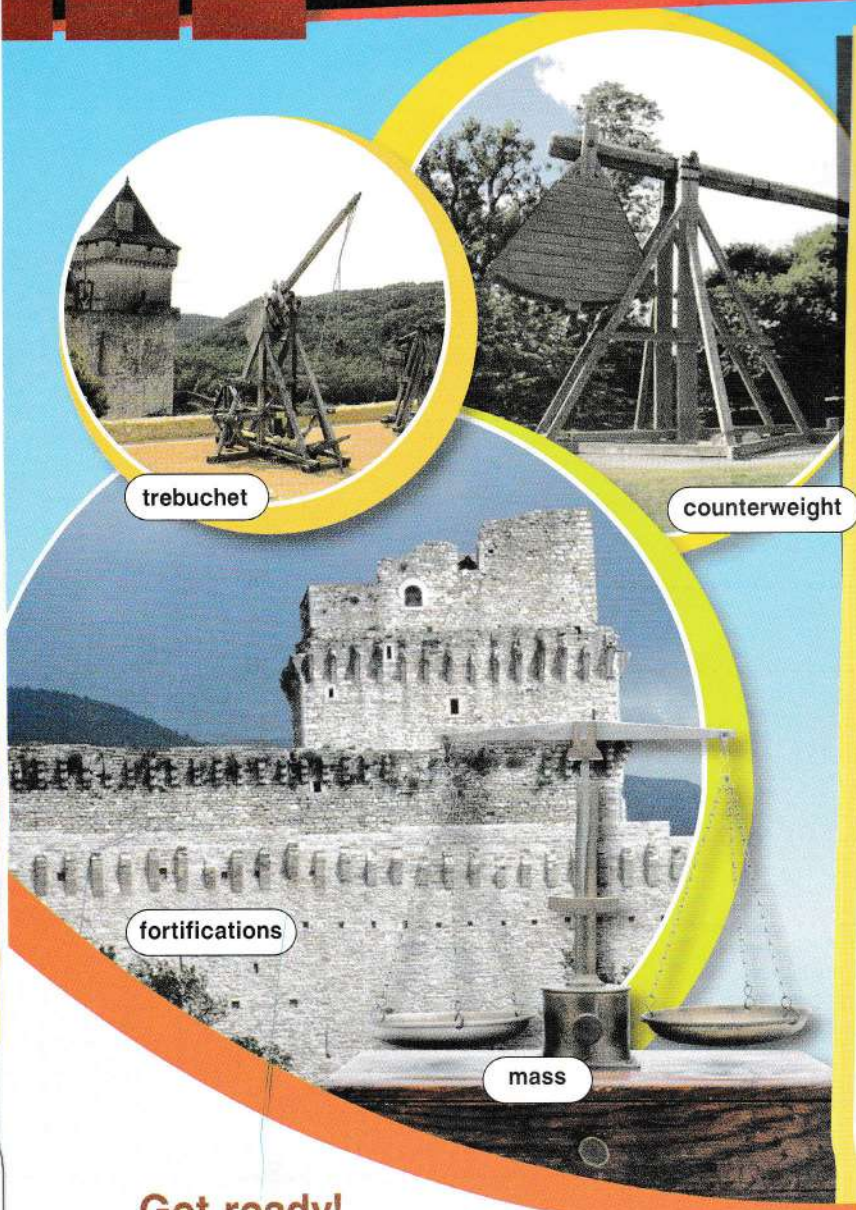
Book 2

Charles Lloyd
James A. Frazier - Jr. MS

Express Publishing

Table of Contents

1 History of engineering

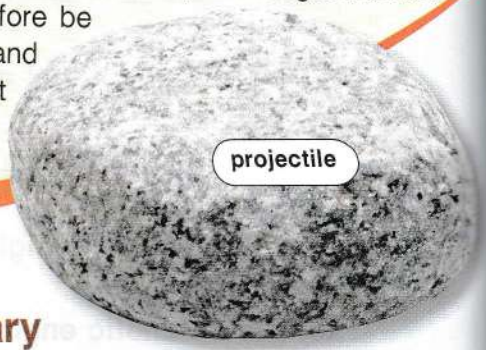


Engineering in the ***Middle Ages***

The Trebuchet

One of the most significant engineering achievements of the Middle Ages was the trebuchet, a type of **catapult**. A common **siege engine**, the trebuchet was used to launch **projectiles** into an enemy's **fortifications** during a siege. This method of breaking down an enemy's defenses was oftentimes quite successful. The trebuchet was a common weapon of warfare for nearly 2,000 years. In fact, it was used well into the 16th century, long after the invention of gunpowder.

The trebuchet launched projectiles at high speeds by utilizing some important engineering principles. One such principle was the **mechanical advantage** principle of leverage. Trebuchets were able to multiply the **torque** that was applied to a simple lever built into their design. This allowed a **counterweight** to provide enough force to launch the **payload** that was in the **sling** on the other side of the **pivot**. The **mass** of the object being launched could therefore be very large and cause great destruction.



Get ready!

1 Before you read the passage, talk about these questions.

1 How was engineering expertise used to make weapons in the Middle Ages?

2 How can we learn from these machines?

Reading

2 Read this passage from a textbook. Then, mark the following statements as true (T) or (F) false.

1 __ Trebuchets use the advantage principal of mass.

2 __ Counterweights and slings are on the same side of a pivot.

3 __ Trebuchets increased the torque being applied to a lever.

Vocabulary

3 Read the sentence pairs. Choose where the words best fit in the blanks.

1 **trebuchets / projectiles**

Catapults can throw _____ very far.

Cannons eventually replaced _____.

2 **pivot / torque**

Applying _____ causes levers to move.

Levers rotate around a _____.

3 **payload / mechanical advantage**

A heavy _____ requires great force to move.

_____ is created by using a lever.

4 Match the words (1-6) with the definitions (A-F).

1 __ siege engine 3 __ catapult 5 __ sling
2 __ mass 4 __ Middle Ages 6 __ counterweight

A the property that makes objects have weight
B the 5th century through the 15th century
C a device designed to throw objects
D a heavy item used to balance a load
E a device used to destroy castle walls
F a device that holds an object

5 Listen and read the passage. Why could a trebuchet cause so much damage?

Listening

6 Listen to a conversation between two engineers. Choose the correct answers.

1 What is the conversation mostly about?
A how to make the crane lighter
B which type of pivot would work best
C why studying history is important
D how trebuchet design might solve a problem

2 Placing the arm closer to the pivot will make it
A longer **B** stronger **C** lighter **D** taller

7 Listen again and complete the conversation.

Engineer 1: I can't believe we're still having trouble with this crane design!
Engineer 2: I know. I was thinking about the problem last night. So I dug up my old college textbook for **1** _____.
Engineer 1: And you found something useful?
Engineer 2: Yeah, I did, actually. Do you remember what a **2** _____ is?
Engineer 1: Sure. It's a **3** _____.
Engineer 2: That's right. And it uses the **4** _____ _____ of leverage.
Engineer 1: Okay, but how does that help us?
Engineer 2: We could do the same thing. Just shorten the arm holding the **5** _____.
Engineer 1: Yeah! And if we make the arm closer to the **6** _____, it would be a stronger support that could handle more weight.

Speaking

8 With a partner, act out the roles below, based on task 7. Then switch roles.

USE LANGUAGE SUCH AS:

Do you remember what a trebuchet is?

Sure. It's a catapult.

Just shorten the arm holding the counterweight.

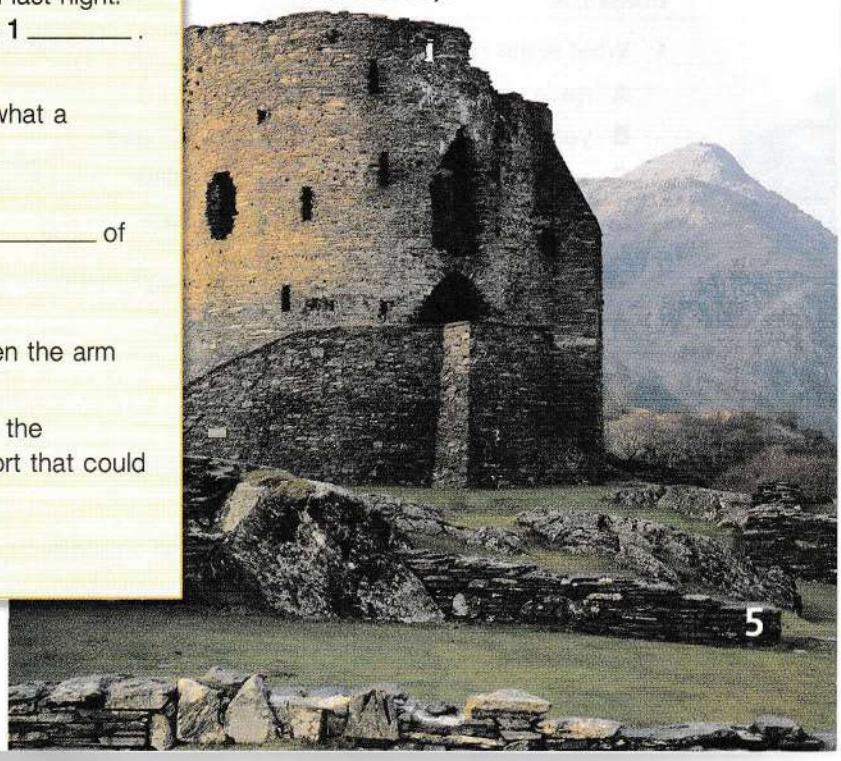
Student A: You are discussing a crane problem. Talk to Student B about:

- trebuchets
- counterweights
- solution

Student B: You are an engineer. Answer Student A's questions.

Writing

9 Use the conversation from Task 8 to write a note to another engineer explaining how you believe trebuchet design can help solve a problem you're having (100-120 words).



2 Traits of an engineer

Get ready!

1 Before you read the passage, talk about these questions.

1 What are good qualities for engineers to have?
2 How can these qualities be developed?

Hire Engineers

http://www.hireengineers.com

LOOKING FOR THE PERFECT ENGINEER

At MiracleCo, we know that having a good education is important. But we're interested in more than just someone with a **degree**. Miracle Co is looking for the perfect engineer!

So what **qualities** must the perfect engineer have?

Obviously, we need an engineer with technical **competency**. Basic **common sense** is a must. Furthermore, having **dependability** means that we trust you. Most importantly, we need an outgoing person with excellent **interpersonal** skills. We want an engineer with the **courage** to tell us when things are going wrong.

Our perfect engineer has good **organizational** skills and uses **quantitative thinking** to assess the work. He or she enjoys the challenge of **problem solving** – this means having the **curiosity** to ask questions. And more than anything else, our perfect engineer thinks about projects in the **long-term** and what they mean for the company.

Do you think you're the perfect engineer for us? Then send your resume to kathyrichards@miracleco.com.

Reading

2 Read this job posting. Then, choose the correct answers.

1 What is the posting about?
- **A** minimum education requirements
- **B** years of experience applicants must have
- **C** an engineering position's responsibilities
- **D** characteristics of a potential employee

2 What is NOT listed as an important quality?
- **A** bravery
- **B** reliability
- **C** punctuality
- **D** curiosity

3 What can you infer about MiracleCo?
- **A** It is hiring several engineers at this time.
- **B** It focuses on short-term projects.
- **C** It values long-term thinking more than courage.
- **D** Its current employees lack interpersonal skills.

Vocabulary

3 Match the words (1-7) with the definitions (A-G).

1 __ organizational skills
2 __ problem solving
3 __ dependability
4 __ curiosity
5 __ common sense
6 __ degree
7 __ quantitative thinking

- **A** trustworthiness
- **B** completion of academic study
- **C** using numbers in thought
- **D** finding solutions
- **E** basic practical knowledge
- **F** ability to keep things in order
- **G** interest in learning

4 Complete the sentences. Fill in the blanks with the correct words from the word bank.

WORD BANK

courage long-term
interpersonal competence quality

1 Carl was fired because he lacked basic _____.
2 Think about your future and _____ career goals.
3 Bob's _____ skills help him communicate well.
4 Alanna's best _____ is her curiosity.
5 It takes _____ to admit you made a mistake.

5 Listen and read the job posting. Why must an engineer be numerate?

Listening

6 Listen to a conversation between an interviewer and an engineer. Mark the following statements as true (T) or false (F).

1 __ The woman is interested in the man's resume.
2 __ The man built a television in college.
3 __ The man has strong interpersonal skills.

7 Listen again and complete the conversation.

Interviewer: So tell me about yourself and what you can bring to MiracleCo.
Engineer: First of all, I have a **1** _____ _____ Electrical Engineering.
Interviewer: I read that on your resume. Tell me what I can't read about.
Engineer: Well, anyone can get a degree, but not everyone has **2** _____.
Interviewer: And you do?
Engineer: I think so. Ever since I was a kid I've always **3** _____ _____ _____.
Interviewer: Can you give me an example?
Engineer: Sure. When I was ten, I took a television apart just to see how it works.
Interviewer: Excellent! Now, how would you rate your **4** _____ skills?
Engineer: I'm very good with people. I ran several **5** _____ _____ _____.

Speaking

8 With a partner, act out the roles below, based on task 7. Then switch roles.

USE LANGUAGE SUCH AS:

Tell me what you can bring to ...?
Not everyone has curiosity.
How would you rate your ... skills?

Student A: You are an interviewer. Ask about Student B:

- qualities
- examples
- interpersonal skills

Student B: You are an engineer. Answer Student A's questions.

Writing

9 Use the job posting and the conversation from Task 8 to complete the interviewer's notes. Make up a name for the applicant.

Interviewer: _____

Applicant: _____

Qualities: _____

_____

_____

Examples: _____

_____

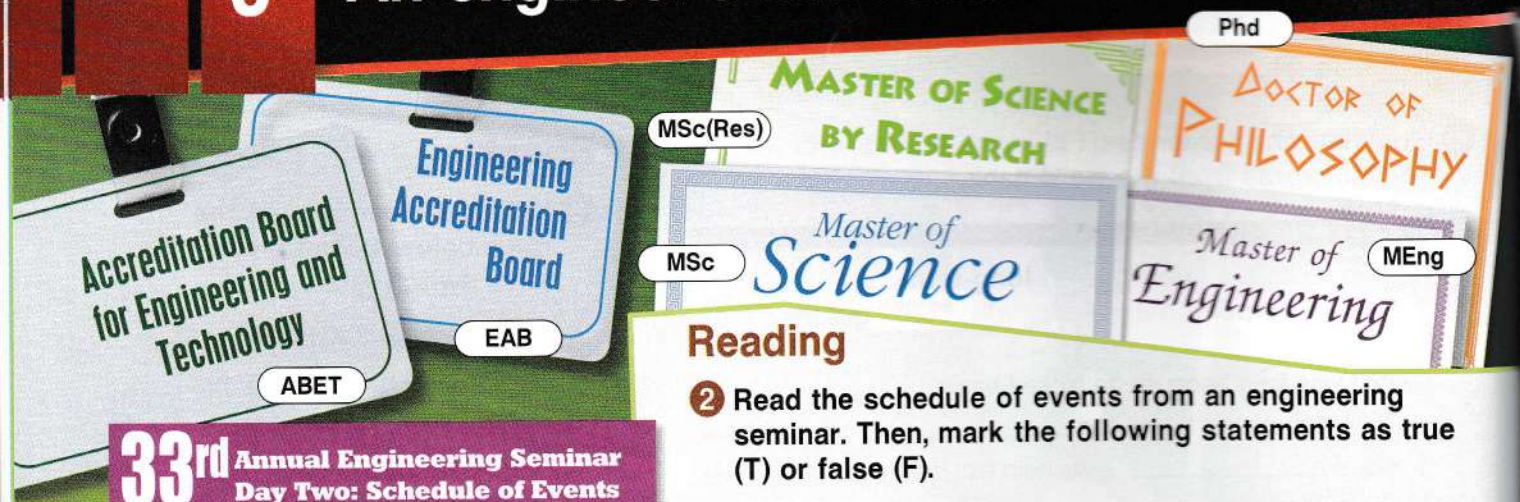
_____

Recommend for hire?

_____

_____

3 An engineer's education



33rd Annual Engineering Seminar
Day Two: Schedule of Events

8:30 a.m.: Auditorium
Al Dietrich, **MSc**
Donald Barney, **MSc(Res)** -
Engineering Ethics

What are engineers' responsibilities for protecting company intellectual property rights?

This session is appropriate for all engineers, as well as those who are currently working on their **undergraduate degrees**. It is particularly helpful for engineers in **entry-level** positions. This event is also **ABET** and **EAB accredited** for one hour of university credit.

Room 110
Victoria Crawford, **PhD** -
Quantum Mechanics,

How does wave-particle duality affect the future of space travel?

This event is designed for engineers who have finished their **doctorates**. Unfortunately, engineers with only a **master's degree** or undergraduate degree will not be admitted.

1:30 p.m.: Room 200
Mary McCormick, **MEng** -
Complex Systems, Analysis II

How can we increase efficiency in complex systems modeling?

This event is designed for engineers with **postgraduate degrees**. Unfortunately, engineers with only a **bachelor's degree** will not be admitted. It is also restricted to engineers who attended Day One's *Complex Systems Analysis I*.

Get ready!

1 Before you read the passage, talk about these questions.

1 What types engineering degrees are there?
2 Why do engineers need a lot of education?

Reading

2 Read the schedule of events from an engineering seminar. Then, mark the following statements as true (T) or false (F).

1 __ A PhD is not required to attend *Engineering Ethics*.
2 __ The space travel session is board accredited.
3 __ The afternoon event is open to engineers with any level of education.

Vocabulary

3 Check (✓) the sentence that uses the underlined parts correctly.

1 __ **A** United Kingdom universities need ABET accreditation.
__ **B** A bachelor's degree requires four years of study.

2 __ **A** Students can earn a master's degree after a bachelor's.
__ **B** To get an MSc, focus on research, not instruction.

3 __ **A** A master's degree in engineering is an MSc(Res).
__ **B** Joe has an entry-level job, but wants a higher position.

4 __ **A** Students earn postgraduate degrees before an MSc.
__ **B** The college wasn't accredited because it didn't meet requirements.

5 __ **A** Sara has a doctorate, the highest level of study.
__ **B** American universities should be EAB accredited.

4 Match the words (1-8) with the definitions (A-H).

1 __ MSc
2 __ postgraduate degree
3 __ MEng
4 __ ABET
5 __ EAB
6 __ MSc(Res)
7 __ undergraduate degree
8 __ PhD

A accrediting body in the United States
B accrediting body in the United Kingdom
C a master's degree in a scientific field
D a master's degree in a scientific field earned through research
E a doctorate
F a master's degree in engineering
G a degree showing four years of study
H any degree achieved after a bachelor's

5 🎧 **Listen and read the schedule. Which seminar is only open to people with PhDs?**

Listening

6 🎧 **Listen to a conversation between two engineers. Choose the correct answers.**

1 What is the main idea of the conversation?

- **A** the importance of ethics in engineering
- **B** where different seminars are being held
- **C** which events the engineers attended yesterday
- **D** why the engineers can only attend certain events

2 The woman will attend Engineering Ethics because

- **A** she only has a bachelor's degree.
- **B** she is not an EAB-certified engineer.
- **C** she arrived too late for other events.
- **D** she missed the previous Complex Systems event.

7 🎧 **Listen again and complete the conversation.**

Engineer 1: Good morning, Samantha. How did things go yesterday?

Engineer 2: Great! The seminar on **1** _____ _____ was fascinating.

Engineer 1: I'm glad to hear it! What are you planning on going to today?

Engineer 2: Actually, I don't have a choice. It has to be **2** _____.

Engineer 1: Why's that?

Engineer 2: Well, unlike you, I only have a **3** _____ _____.

Engineer 1: Ah, yes. I noticed a few of the events require **4** _____ _____.

Engineer 2: Yeah. So ... which events do you want to **5** _____ today?

Engineer 1: I'd really like to **6** _____ _____ Complex Systems Analysis II, but I can't.

Speaking

8 **With a partner, act out the roles below, based on task 7. Then switch roles.**

USE LANGUAGE SUCH AS:

What are you planning on going to today?

Actually, I don't have a choice.

I noticed a few of the events require ...

Student A: You are at a seminar with another engineer. Talk to Student B about:

- seminars you each want to attend
- education required

Make up a name for your colleague.

Student B: You are at a seminar. Answer Student A's questions.

Writing

9 **Use the conversation from Task 8 to fill in the seminar feedback form. Be sure to include the lack of options for certain engineers.**

Engineering Seminar Feedback

Engineer Name: _____

What level of education do you have?

_____

What events did you attend? What were the requirements?

_____

_____

Were you pleased with the number of events available to you? Please explain your answer.

_____

_____

Please rate your overall experience at the seminar, with 1 being the lowest and 10 the highest.

1 2 3 4 5 6
7 8 9 10

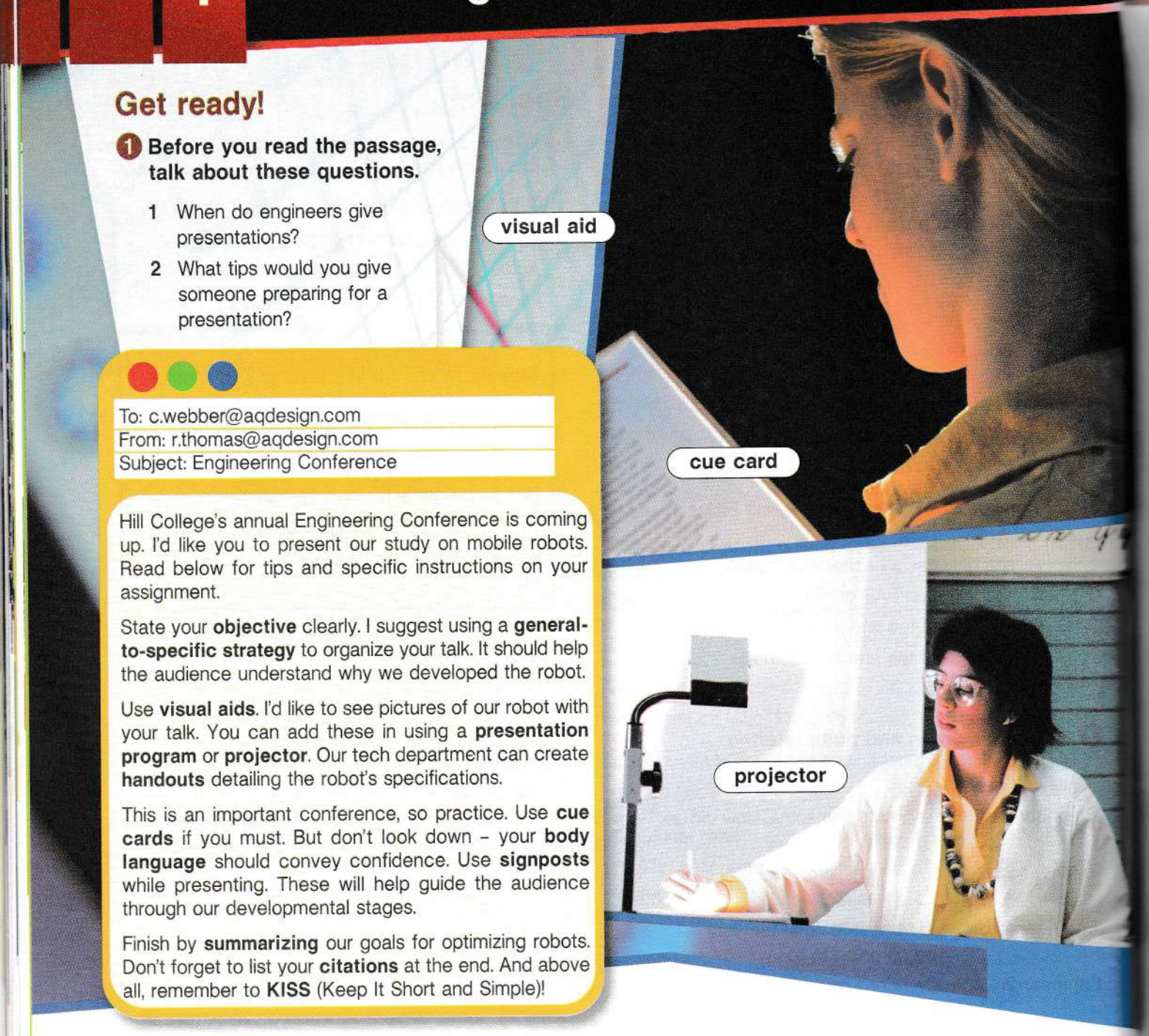
4 Presenting information

Get ready!

1 Before you read the passage, talk about these questions.

1 When do engineers give presentations?

2 What tips would you give someone preparing for a presentation?



To: c.webber@aqdesign.com
From: r.thomas@aqdesign.com
Subject: Engineering Conference

Hill College's annual Engineering Conference is coming up. I'd like you to present our study on mobile robots. Read below for tips and specific instructions on your assignment.

State your **objective** clearly. I suggest using a **general-to-specific strategy** to organize your talk. It should help the audience understand why we developed the robot.

Use **visual aids**. I'd like to see pictures of our robot with your talk. You can add these in using a **presentation program** or **projector**. Our tech department can create **handouts** detailing the robot's specifications.

This is an important conference, so practice. Use **cue cards** if you must. But don't look down – your **body language** should convey confidence. Use **signposts** while presenting. These will help guide the audience through our developmental stages.

Finish by **summarizing** our goals for optimizing robots. Don't forget to list your **citations** at the end. And above all, remember to **KISS** (Keep It Short and Simple)!

Reading

2 Read this email from a supervisor to an engineer. Then, mark the following statements as true (T) or false (F).

1 ___ A general-to-specific organization is recommended.

2 ___ The employee should begin with a summary of goals.

3 ___ A signpost is an example of a visual aid.

Vocabulary

3 Match the words (1-6) with the definitions (A-F).

1 ___ signpost
2 ___ general-to-specific strategy
3 ___ presentation program
4 ___ body language
5 ___ summarize
6 ___ citation

A a program that displays a slide show
B a phrase or word that signals a change in topic
C a reference from a piece of writing
D to repeat the main points of something
E communication through body movements
F organization style in which specific details follow basic ideas

4 Write a word that is similar in meaning to the underlined part.

1 What is the main goal of this project?
o _ _ e _ t _ v _
2 Use a machine that shows images on a screen.
_ r o _ _ _ t _ r
3 Write the important points on a small, firm piece of paper.
c _ _ _ a _ d
4 Remember the basic rule: do things in the simplest way.
K _ _ S
5 Include images that express information in the lecture.
_ i _ _ a _ a _ d _
6 Did the speaker give out any documents related to the lecture?
h _ _ d _ u _ s

5 Listen and read the email. When should the presenter talk about the books and articles that they read to help them with the project?

Listening

6 Listen to a conversation between an engineer and his co-worker. Mark the following statements as true (T) or false (F).

1 __ The presentation was organized poorly.
2 __ The woman suggests clarifying the objective.
3 __ The man appeared nervous while presenting.

7 Listen again and complete the conversation.

Presenter: Janet, what did you think of my practice presentation?
Co-worker: I thought it was **1** _____ _____, Jangmin. You stated your objective of optimizing mobile robots very clearly.
Presenter: Was my **2** _____ of the robot's design phase confusing?
Co-worker: No. The general-to-specific organization made it **3** _____ _____ _____.
Presenter: Great. Do you have any advice to **4** _____ _____ _____?
Co-worker: Maybe you can work on your delivery a little.
Presenter: What exactly should I change?
Co-worker: Just be aware of your **5** _____ _____. You were moving around a lot. And **6** _____ _____ _____ your cue cards too much.

Speaking

8 With a partner, act out the roles below, based on task 7. Then switch roles.

USE LANGUAGE SUCH AS:

What did you think of ...?

Do you have any advice to help me improve?

Maybe you can work on ... a little.

Student A: You just practiced your presentation with a co-worker. Ask Student B about:

- opinion of presentation
- confusing areas
- advice for improvement

Make up a name for your co-worker.

Student B: You just listened to a co-worker's presentation. Answer Student A's questions.

Writing

9 Use the conversation from Task 8 to complete the evaluation of the engineer's practice presentation.

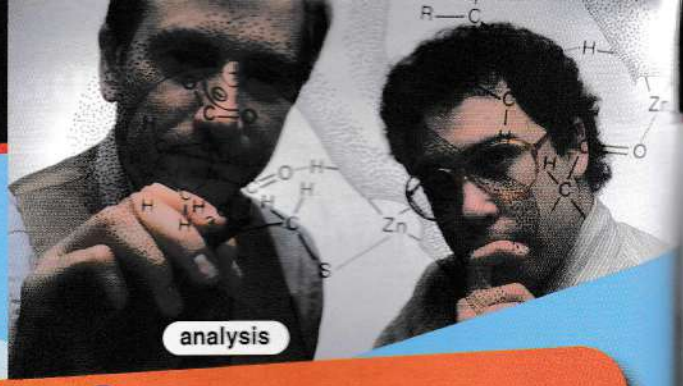
Practice Presentation

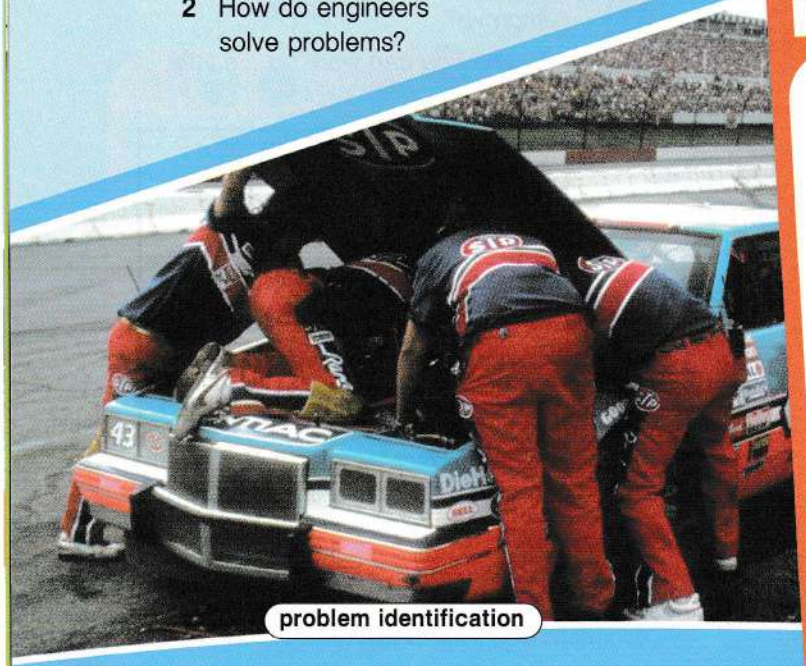
Positive aspects of presentation:
_____
_____
_____

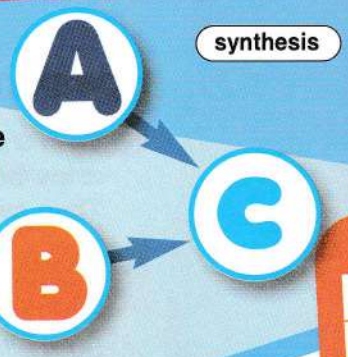
Negative aspects:
_____
_____
_____

Advice:
_____
_____
_____

5 Problem solving







Get ready!

1 Before you read the passage, talk about these questions.

1 What kinds of problems do engineers solve?

2 How do engineers solve problems?

From: Charlene Brand <cbrand@windowco.com>
To: Eric Marks <emarks@windowco.com>
Subject: Problem Update

Eric,
As you know, our **problem identification** process revealed a serious inefficiency with our Crystal-Clear line of windows. They allow too much heat loss. After much **analysis** we deemed the glass to be the root cause of the problem.

To **attack** this issue, we've employed an **iterative procedure**. **Logic** suggested that thicker glass would retain heat. So in the first **iteration,** we used thick glass. This worked, but **application** became a problem – the glass is too expensive. Thus, we've **redefined** the problem, but we've kept the same **approach**. How do we create a cost-effective window that retains heat?

Our second iteration used two thin panes. This held in more heat, but the glass was too fragile.

I decided the third iteration will be a **synthesis** of the previous two iterations. That means we're using two slightly thicker panes.

I'll keep you posted on the results of this attempt. I expect this **comprehension** to lead to a **solution** soon.

Charlene

Reading

2 Read this e-mail from an engineer. Then, choose the correct answers.

1 What is the note about?
- **A** testing glass for fragility
- **B** how to identify a problem
- **C** making an efficient window
- **D** rescheduling iterative procedures

2 What changed during the second stage?
- **A** The window was thicker.
- **B** The window was too expensive.
- **C** The window used multiple panes.
- **D** The window retained too much heat.

3 Which is NOT true about the process so far?
- **A** Thick glass is expensive.
- **B** The thin panes are fragile.
- **C** The two panes released more heat.
- **D** The third iteration will use two panes.

Vocabulary

3 Match the words (1-8) with the definitions (A-H).

1 __ comprehension
2 __ iterative procedure
3 __ approach
4 __ problem identification
5 __ synthesis
6 __ analysis
7 __ logic
8 __ redefine

- **A** a close examination of something
- **B** to state something again
- **C** a combination of data and theory
- **D** the determination of what is wrong
- **E** a way of dealing with a problem
- **F** reasonable thinking
- **G** the repetition of steps to solve a problem
- **H** the mixing of ideas

4 Use the words from the word bank to fill in the blanks.

WORD BANK

solution iteration
attack application

1 Work until you find a _____ to this problem.
2 Is there a useful _____ for this new product?
3 What is the best way to _____ this problem?
4 On each _____, change only one step.

5 Listen and read the email. How many new designs have been tried?

Listening

6 Listen to a conversation between two engineers. Mark the following statements as true (T) or false (F).

1 __ The woman has not begun the third iteration.
2 __ The woman suggests testing the glass again.
3 __ The woman tested the strength of cheap glass.

7 Listen again and complete the conversation.

Engineer 1: Hey, Charlene. Where are you with the **1** _____ _____?
Engineer 2: Well, we just finished the third **2** _____ of the process.
Engineer 1: Using two thicker panes? How did that go?
Engineer 2: The window retained enough heat and wasn't too fragile.
Engineer 1: What about the **3** _____ _____?
Engineer 2: Manufacturing **4** _____ _____ _____ _____ window will be expensive.
Engineer 1: How are you going to **5** _____ _____ problem?
Engineer 2: We have **6** _____ _____. We could try another iteration with one pane.

Speaking

8 With a partner, act out the roles below, based on task 7. Then switch roles.

USE LANGUAGE SUCH AS:

Where are you with the ...?
What about the ... issue?
We can look for cheaper ....

Student A: You want to know about a problem solving process. Ask Student B about:

- status of the problem
- results of last iteration
- new problems

Make up a name for your co-worker.

Student B: You are working on the problem. Answer Student A's questions.

Writing

9 Use the email and the conversation from Task 8 to complete the engineer's e-mail, stating what he/she has done so far and asking for advice about what to do next.

From: _____
To: _____
Subject: Problem update

_____
_____
_____
_____
_____
_____
_____

What do you think?

_____

6 Creativity

Get ready!

1 Before you read the passage, talk about these questions.

1 What helps you think creatively?
2 Why is creative thinking valuable in engineering?

Reading

2 Read this notice from an engineering journal. Then, mark the following statements as true (T) or (F) false.

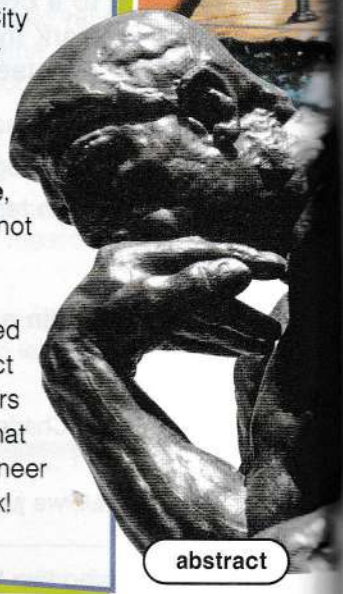
1 __ The challenge is to create abstract ideas.
2 __ The NAE will check that ideas are original.
3 __ A group of engineers will criticize entries.

National Association of Engineers (NAE) City Challenge

The annual City Challenge is back! It's time to test your powers of **innovation** and design a solution to a problem your city faces. The designs you create should break from the **norm** and defy **convention**. They should be **creative**, **out-of-the-box** designs that share your **vision** of the future!

We all know that every city has problems. City Challenge aims to solve those problems by bringing together the brightest engineers from all over the country. By tackling the issues that face us, we can make our cities better places to live. We're looking for **concrete**, **plausible** ideas that can be put into action, not just **abstract** notions!

All City Challenge entries are submitted electronically. Your idea's **originality** is subject to **verification**. All entries are judged by leaders in our field. In fact, **feedback** will come from that team. A cash prize will be awarded to the engineer whose design is chosen to be built. Good luck!



Vocabulary

3 Write a word that is similar in meaning to the underlined part.

1 Get results that are <u>existing in reality</u>. _ _ n _ _ e _ e
2 Think <u>different than the usual manner</u>.
o _ _ _ f t _ _ _ _ x
3 This is just a <u>theoretical</u> idea.
_ _ s _ _ a _ t
4 Is this plan <u>reasonable or achievable</u>? _ l _ _ s _ _ _ e
5 The scientific method is an accepted <u>general practice</u>.
c _ _ _ e _ _ i _ _
6 GearCo's <u>unique quality</u> makes it successful.
_ r _ _ i _ _ _ _ t _
7 Scientists question the <u>commonly-held ideas</u>. _ _ r _

4 Use the words from the word bank to fill in the blanks.

WORD BANK

verification feedback creative
innovation vision

1 Ignore the results until we get _____ .
2 _____ people have great new ideas.
3 In Bob's _____ of the future, he is an engineer.
4 Provide _____ on the project's pros and cons.
5 _____ lets companies make new projects.

5 Listen and read the notice. Who will decide which project is best?

Listening

6 🎧 **Listen to a conversation between two engineers. Choose the correct answers.**

1 What is the conversation mainly about?

- **A** the entries received so far
- **B** the least impressive contest entries
- **C** the lack of creativity in the entries
- **D** the verification checks of entries

2 What can be inferred about last year's contest entries?

- **A** They were more numerous.
- **B** They were less creative.
- **C** They did not produce a winner.
- **D** They failed verification checks.

7 🎧 **Listen again and complete the conversation.**

Engineer 1: The City Challenge entries are so creative! Much better than last year.

Engineer 2: I haven't seen them yet. Which ones impress you the most?

Engineer 1: Well, one of them solves the problem of a city office building overheating.

Engineer 2: How did the engineer do it?

Engineer 1: By simply **1** _____ _____ _____ _____ with cooler exterior air.

Engineer 2: Interesting. By adding more air conditioning capacity?

Engineer 1: **2** _____ _____ _____. She installed an inexpensive heat pump.

Engineer 2: Not a bad idea–but it's not terribly **3** _____. Any others?

Engineer 1: Yes, there's another entry from an engineer who solves the problem of icy sidewalks.

Engineer 2: Sounds interesting. What did that person do?

Engineer 1: He installs pipes under the sidewalks. Hot water **4** _____ _____ the pipes and melts the ice.

Engineer 2: Hmm ... nice, it might take **5** _____ _____ _____ to heat the water though.

Engineer 1: No–he uses **6** _____ _____ to produce electricity.

Speaking

8 **With a partner, act out the roles below, based on task 7. Then switch roles.**

USE LANGUAGE SUCH AS:

The entries are so ...

Which one impresses you the most?

What did that person do?

Student A: You are discussing the contest entries. Talk to Student B about:

- problems the entries try to solve
- the best entry
- improving the entry

Student B: You are an engineer. Answer Student A's questions.

Writing

9 **Use the conversation from Task 8 to fill out a feedback form for a City Challenge entry.**

City Challenge Entry Feedback

Name of Entry: _____

Was the Entry's Originality Verified? Y / N

Description of the Entry:

_____

_____

Evaluation of the Entry:

Strengths: _____

Suggestions: _____

_____

_____

7 Tables and graphs

Get ready!

1 Before you read the passage, talk about these questions.

1 What are graphs used for?
2 How do graphs help engineers?

PRODUCTION PROGRESS REPORT

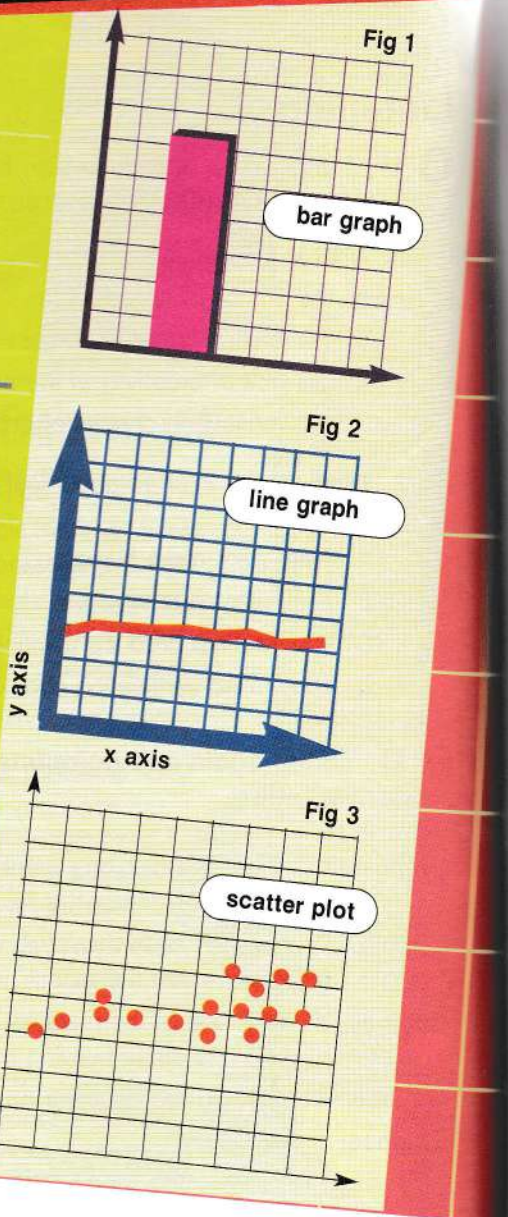
Date: May 4

Charting the progress of our motor production has revealed some interesting data. Please see the **graphs** in figures 1 through 3.

The **bar graph** in figure 1 shows our monthly production numbers for motors. Months are represented on the **x axis**, while the total units produced is on the **y axis**.

In figure two the **line graph** shows the cost of the motors over time. Here the **dependent variable** is the production cost, while the **independent variable** is the time in periods of months. As you can see, the line is almost flat. We can keep producing inexpensive motors without sacrificing quality.

Finally, the **scatter plot** in figure 3 shows the relationship between what our motors are used for and the number of times they break down. Notice that the more intensive uses mean more breakdowns. But the overall number of breakdowns remains low compared to our competitors.



Reading

2 Read this report on motor production. Then, choose the correct answers.

1 What is this report about?
- **A** increasing the sales of motors
- **B** reducing production costs
- **C** showing production numbers
- **D** researching motor problems

2 What does the line graph show?
- **A** increasing breakdowns
- **B** low production numbers
- **C** loss of quality over time
- **D** steady cost of production

3 What can you infer about the motors?
- **A** They have multiple uses.
- **B** They are expensive to produce.
- **C** They are not produced year-round.
- **D** They fail more often than competitors' motors.

Vocabulary

3 Match the words (1-6) with the definitions (A-F).

1 __ bar graph
2 __ independent variable
3 __ x axis
4 __ dependent variable
5 __ y axis
6 __ scatter plot

- **A** the vertical axis on a graph
- **B** a diagram that shows data with rectangles
- **C** a value that is changed by other factors
- **D** the horizontal axis on a graph
- **E** a value that is not changed by other factors
- **F** a chart with many points on it

4 **Use the words from the word bank to fill in the blanks.**

WORD BANK

axis graphs coordinates line graph

1 _____ use bars, lines or circles to show data.
2 A _____ is made by points connected with lines.
3 The x _____ is always a horizontal line on a graph.
4 _____ are typically represented as points on a graph.

5 **Listen and read the report. Which graph shows how often their cars must be repaired?**

Listening

6 **Listen to a conversation between a two engineers. Mark the following statements as true (T) or false (F).**

1 __ The woman recommends a scatter plot.
2 __ The man has used several bar graphs.
3 __ The woman suggests using more color.

7 **Listen again and complete the conversation.**

Engineer 1: Hi, Ted. Have you finished making the monthly report yet?
Engineer 2: Almost – I just have to finish the last graph. But I'm just not sure which type I should use.
Engineer 1: Well, what do you need to show? I mean, what will the numbers represent?
Engineer 2: I need to show how cost of materials has gone up this year.
Engineer 1: Easy enough. A scatter plot graph is **1** _____ _____ _____ _____, of course.
Engineer 2: Right. I was considering either a line graph or a **2** _____ _____.
Engineer 1: There are other graphs in the report, **3** _____ _____? What are they?
Engineer 2: Um ... so far, I've just used **4** _____ _____. There are at least four of them already.
Engineer 1: In that case, I'd use a bar graph, for sure.
Engineer 2: I think I see your point. You're saying that I need more diversity.
Engineer 1: Exactly. The whole point is to **5** _____ _____ _____. I'd add some color too.
Engineer 2: Great idea. I'll be sure to spice it up with some **6** _____-_____ _____.

Speaking

8 **With a partner, act out the roles below, based on task 7. Then switch roles.**

USE LANGUAGE SUCH AS:

Have you finished making the ...?
I need to show ...
I'd use a ...

Student A: You need to make a graph. Talk to Student B about:

- graphs used already
- suggested graphs
- adding visual interest

Make up a name for your co-worker.

Student B: You are Student A's co-worker. Answer his or her questions.

Writing

9 **Use the conversation from Task 8 to complete the engineer's review of a co-worker's report.**

GRAPH REVIEW

Name: _____
Report: _____
Problems: _____
_____
_____
Recommendations: _____
_____
_____

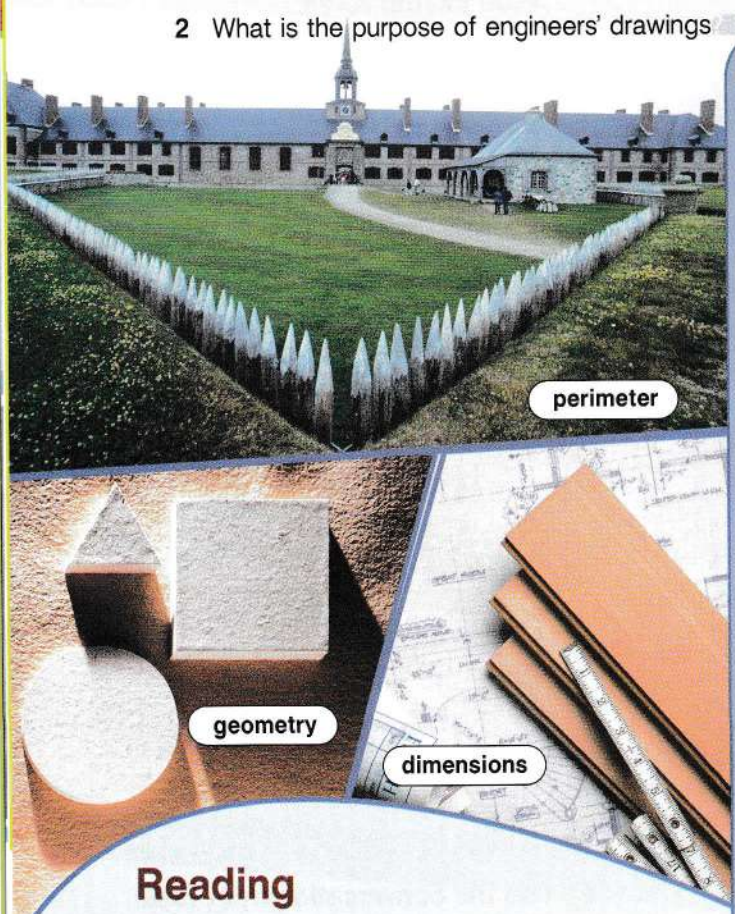
8 Dimensions and drawings

Get ready!

1 Before you read the passage, talk about these questions.

1 What kind of drawings do engineers make?

2 What is the purpose of engineers' drawings



To: Julia Smith [jsmith@designplus.com]
From: Dave Tanaka [dtanaka@designplus.com]
Subject: Notes on cell phone

Julia,

After many meetings and cost analyses, we're finally moving forward with the cell phone project to expand, for the first time, into the communications market.

What I need from you in these early stages is a **CAD drawing** detailing the **schematics** of the device.

The blueprint should include details for the **dimensions** of the phone. This includes the device's **length, width, depth** and the **perimeter** of the screen.

As for **scale**, the device is small. So make the drawing at least four times larger than the device.

The **diagram** also needs an **exploded view** to show how the components will fit together. This includes the circuit board, battery, microphone, speakers and liquid crystal display. We also need a **cross-section** of the phone to see those components all within the outer casing.

Don't forget to show the **geometry** of the phone from different angles.

Please contact me with any questions you have.

-Dave

Reading

2 Read this email from an engineer. Then, choose the correct answers.

1 What is the note about?

- **A** drawing a cell phone diagram
- **B** determining the scale of a cell phone
- **C** choosing materials to make a cell phone
- **D** explaining a cell phone's dimensions

2 Which is NOT true about the engineer's request?

- **A** He wants different views of the phone.
- **B** He wants to see what's inside the phone.
- **C** He wants to know the dimensions.
- **D** He wants the drawing to be actual size.

3 What can you infer about the company?

- **A** It recently hired new engineers.
- **B** It typically makes larger devices.
- **C** It has never made cell phones before.
- **D** It provides cost analysis to engineers.

Vocabulary

3 Match the words (1-8) with the definitions (A-H).

1 __ depth
2 __ geometry
3 __ width
4 __ diagram
5 __ cross-section
6 __ schematic
7 __ dimensions
8 __ length

- **A** a drawn plan of something
- **B** height, width and depth
- **C** deepness
- **D** wideness
- **E** how long something is
- **F** a diagram showing an object's inside
- **G** shape
- **H** the form and features of something

4 **Use the words from the word bank to fill in the blanks.**

WORD BANK

perimeter exploded views
scale CAD drawing

1 _____ show how machines' pieces fit together.
2 Draw the plans at a small _____.
3 The _____ shows the layout of the new machine.
4 Add all sides to calculate the _____.

5 **Listen and read the email. How much bigger will the drawing be than the phone itself?**

Listening

6 **Listen to a conversation between two engineers. Mark the following statements as true (T) or false (F).**

1 __ The note didn't include the dimensions.
2 __ The depth of the phone is 1 inch.
3 __ The screen size has not been determined.

7 **Listen again and complete the conversation.**

Engineer 1: Dave, we have a problem. Do you have a minute?
Engineer 2: Sure thing. Is it about the **1** _____ _____ _____ _____?
Engineer 1: Yeah, actually. Your note didn't include the **2** _____.
Engineer 2: Sorry about that. So, the phone has a **3** _____ of 6 inches and a **4** _____ of 2 inches.
Engineer 1: What about the depth?
Engineer 2: That's going to be half an inch.
Engineer 1: Half an inch? Is there **5** _____ _____ for the battery?
Engineer 2: Yeah, we're using the L20 battery. It's not even a **6** _____ _____ _____ _____ thick.
Engineer 1: What about the screen?
Engineer 2: We want a 2 by 1.5 inch screen. So, can you get this done by tomorrow?
Engineer 1: Will do. I'll bring it over as soon as I'm finished.
Engineer 2: Thanks a lot.

Speaking

8 **With a partner, act out the roles below, based on task 7. Then switch roles.**

USE LANGUAGE SUCH AS:

Is it about the ... CAD drawings?
You didn't include the dimensions.
Is that enough room for the battery?

Student A: You're creating CAD drawings. Ask Student B about:

- dimensions
- battery size
- screen size

Student B: You are an engineer. Answer Student A's questions.

Writing

9 **Use the conversation from Task 8 to complete the engineer's notes about the new product.**

PROJECT NOTES

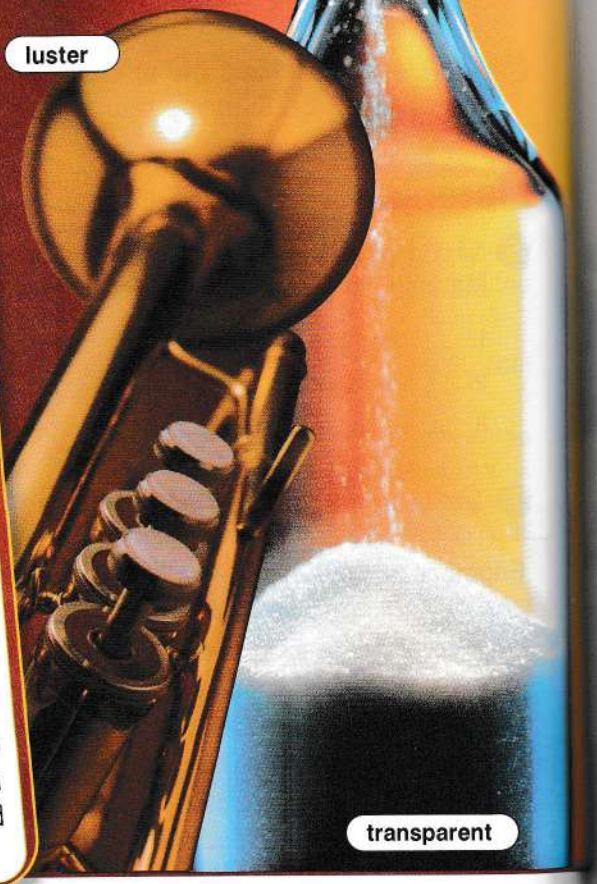
Engineer: _____
Product: _____
Dimensions: _____
Battery type: _____
Battery dimensions: _____
Screen dimensions: _____

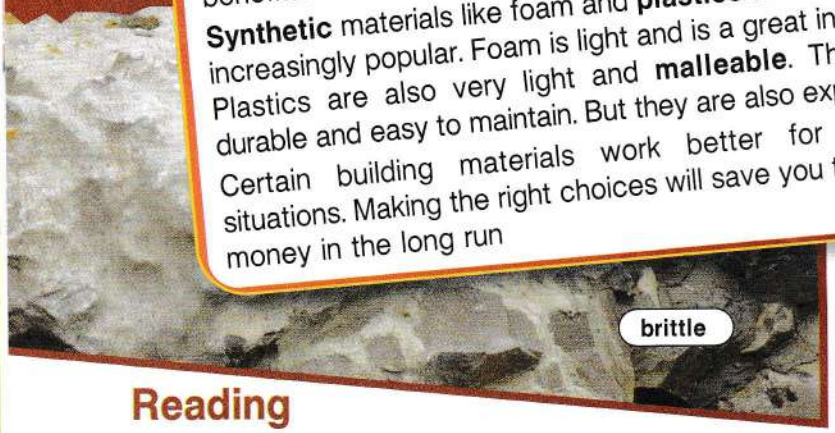
9 Materials and properties

Get ready!

1 Before you read the passage, talk about these questions.

1 What kinds of materials do people use to build structures?
2 Why are some materials better for projects than others?





Construction Basics

http://www.construction.com

Construction Basics: Understanding Your Materials

Many kinds of building materials are available today, and they all have different properties. Understanding these materials can help you make the best choice for your project.

Natural materials are always popular options. These include wood, glass, and metal. Wood is a good **insulator**. But it only has moderate **tensile** strength. Glass is a **transparent** material suitable for windows. But it is also very **brittle**. Metals are useful for the frameworks of structures. They are great **conductors** and have lots of **luster**. Their high **ductility** and **hardness** are other benefits.

Synthetic materials like foam and **plastics** are becoming increasingly popular. Foam is light and is a great insulator. Plastics are also very light and **malleable**. They are durable and easy to maintain. But they are also expensive. Certain building materials work better for certain situations. Making the right choices will save you time and money in the long run

Reading

2 Read this page from the website of Abel Construction Co. Then, complete the table using information from the passage.

Material	Properties
Glass	_____
Metal	_____
Plastic	_____

Vocabulary

3 Match the words (1-6) with the definitions (A-F).

1 __ malleable
2 __ natural
3 __ plastic
4 __ insulator
5 __ ductility
6 __ luster

A a material's ability to not break
B coming from nature, such as wood
C a material that contains heat or electricity
D the brightness or shine of a metal
E easily shaped or bent
F a common synthetic material

4 **Check (✓) the sentence that uses the underlined parts correctly.**

1 ___ **A** Cotton is a <u>synthetic</u> material.
___ **B** Glass is <u>brittle</u> and can shatter.

2 ___ **A** You can stretch rubber because it has very low <u>tensile</u> strength.
___ **B** Foam retains heat well and is a good <u>conductor</u>.

3 ___ **A** Most glass is <u>transparent</u>.
___ **B** Metals have low levels of <u>hardness</u>.

5 🎧 **Listen and read the webpage. What is the problem with plastic as a building material?**

Listening

6 🎧 **Listen to a conversation between an engineer and her client. Mark the following statements as true (T) or false (F).**

1 ___ The client wants to use synthetic materials.
2 ___ The engineer recommends steel over wood.
3 ___ The client has little money for the project.

7 🎧 **Listen again and complete the conversation.**

Client: Hi Beth. I'm calling regarding the building materials for the new park swing set.
Engineer: Okay. What can I do for you?
Client: I need advice on materials for the framework. I want to use **1** _____ materials.
Engineer: Well, your two main options are wood and steel.
Client: Which do you recommend?
Engineer: Steel's ductility makes it a **2** _____ _____. And it's not **3** _____, so it won't break from frequent use.
Client: Is it more expensive than wood?
Engineer: Yes, it does cost more. Is that **4** _____ _____?
Client: Somewhat. I'm **5** _____ _____ _____ _____.
Engineer: Well, wood is cheaper. But it absorbs moisture over time. This reduces its **6** _____.
Client: So is steel the better value?
Engineer: Yes. At least in the long term. It's very durable and requires less maintenance than wood.

Speaking

8 **With a partner, act out the roles below, based on task 7. Then switch roles.**

USE LANGUAGE SUCH AS:
What can I do for you?
I need advice on materials for the ...
Which do you recommend?

Student A: You are building a new swing set. Ask Student B questions to find out:
- options for materials
- recommendation
- costs

Student B: You are an industrial engineer. Answer Student A's questions.

Writing

9 **Use the webpage and the conversation from Task 8 to complete the client's notes.**

MATERIALS FOR PROJECT

Options: _____

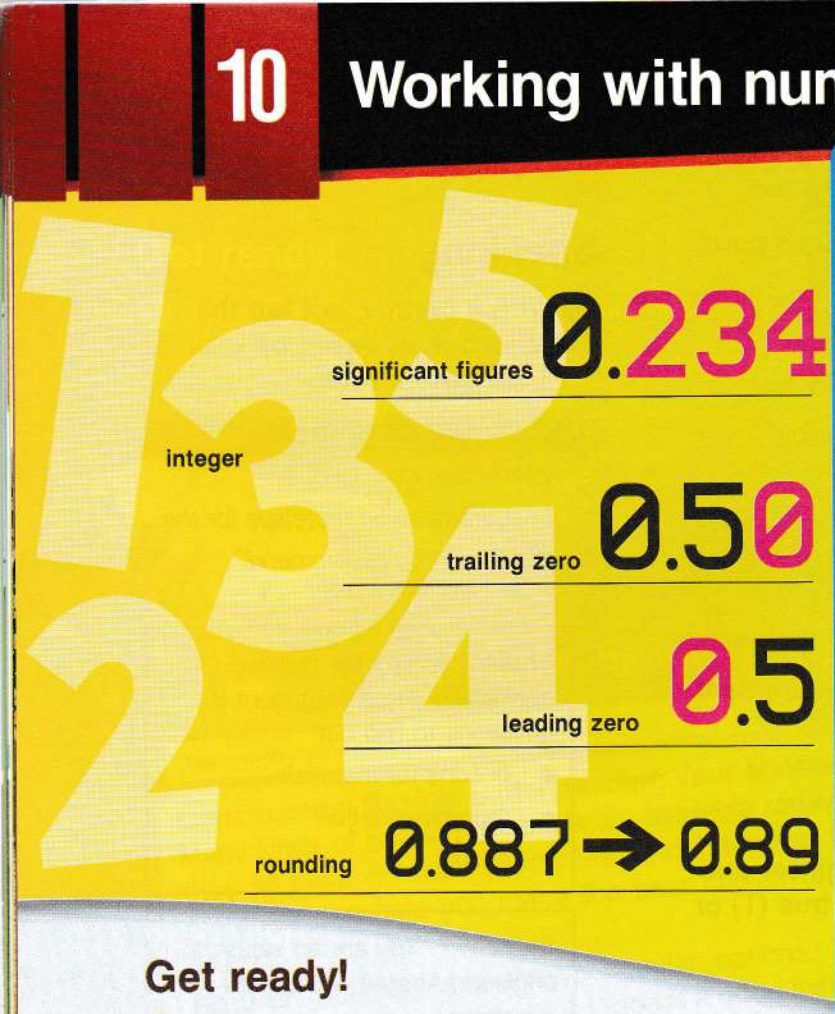
Benefits/Drawbacks of each material:

_____
_____
_____
_____

Better value:

_____
_____
_____
_____

10 Working with numbers



From: dbaker@gbaassociates.com
To: staff@gbaassociates.com
Subject: Decimals

All,

There's been an issue with some of our **calculations**. Specifically, one of our engineers left off a **leading zero** and a decimal point on a machine part order. As a result, we almost made a part that was 5 centimeters long instead of 0.5 centimeters. That's one **order of magnitude** larger than it's supposed to be! These types of errors keep us from doing our work properly. So let's go through a few of the **conventions** you all need to keep in mind.

Always round to three **significant figures**. This ensures that everything is kept to the same standard and avoids **rounding errors**. Don't forget that **trailing zeros** are always considered significant if you are using decimal **notation** for **integers**. Also, every time you're expressing very large or small **quantities**, use **scientific notation**. That keeps things precise. When you're doing this, don't forget that every **digit** is significant!

Thank you all for your cooperation.
Diana

calculation

Get ready!

1 Before you read the passage, talk about these questions.

1 When do engineers work with numbers?
2 How do you avoid making mistakes with numbers?

Reading

2 Read this email from a supervisor to her employees. Then, choose the correct answers.

1 What is the email mostly about?
- **A** a way to avoid future calculation errors
- **B** an incorrectly formed machine part
- **C** a new way to express quantities
- **D** the need to improve manufacturing precision

2 Which of the following is NOT a convention?
- **A** rounding to three significant figures
- **B** expressing integers as decimals
- **C** making trailing zeros significant
- **D** using scientific notation

3 What can be inferred about the machine-part?
- **A** It was made 4.5 centimeters too long.
- **B** It was thrown away because it was useless.
- **C** It was not actually made by the company.
- **D** Its ordering was approved by D. Baker.

Vocabulary

3 Check (✓) the sentence that uses the underlined parts correctly.

1 ___ **A** Negative and positive numbers can be integers.
___ **B** Quantities are not considered significant.

2 ___ **A** Place calculations before decimal points.
___ **B** Round the answer to four significant figures.

3 ___ **A** The digit system shows small numbers.
___ **B** Decimals can include trailing zeros.

4 ___ **A** Using conventions reduces confusion.
___ **B** Computers perform notations faster than humans.

5 ___ **A** Decimals less than one need a leading zero.
___ **B** Improper rounding leads to an order of magnitude.

6 ___ **A** Adding numbers often creates a rounding error.
___ **B** Use scientific notation to express large numbers.

4 **Use the words from the word bank to fill in the blanks.**

WORD BANK

digits calculations notations
order of magnitude rounding error quantity

1 The figure was incorrect because of a(n) _____.
2 The factory produced a lower _____ than expected.
3 A misplaced decimal makes a number one _____ off.
4 A phone number includes ten _____.
5 Jenny can do complex _____ in her head.
6 Math uses different _____ to express numbers.

5 **Listen and read the email. How many conventions are listed in the email?**

Listening

6 **Listen to a conversation between an engineer and his supervisor. Mark the following statements as true (T) or false (F).**

1 __ The supervisor noticed the engineer's mistake.
2 __ The engineer wrote 0.5 inches on the form.
3 __ The engineer was two orders of magnitude off.

7 **Listen again and complete the conversation.**

Engineer: What exactly did I do wrong?
Supervisor: When you requested a part for the machine you're designing, you were one **1** _____ _____ _____ off.
Engineer: Oh. I thought I put down **2** _____ centimeters!
Supervisor: As I said in the email, you forgot the **3** _____ _____ and the **4** _____.
Engineer: So I wrote 5 centimeters instead?
Supervisor: That's exactly right, George.
Engineer: That's a **5** _____ _____ _____, isn't it? What happens now?
Supervisor: Just don't forget the **6** _____ that we use and you'll be fine.
Engineer: All right. Well, again, I'm really sorry about all this.

Speaking

8 **With a partner, act out the roles below, based on task 7. Then switch roles.**

USE LANGUAGE SUCH AS:

What exactly did I do wrong?
You forgot ...
That's a pretty big mistake, isn't it?

Student A: You are talking to your supervisor. Talk to Student B about:

- an error
- the solution
- avoiding mistakes

Student B: You are a supervisor. Answer Student A's questions.

Writing

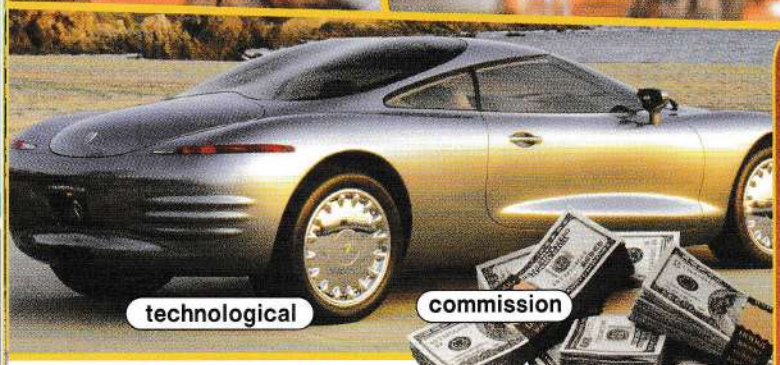
9 **Use the email and the conversation from Task 8 to write an email to a colleague about a mistake they made and how to avoid it in the future (100-120 words).**

11 Sales engineering


market research


liaison


demonstrate


technological

commission

Get ready!

1 Before you read the passage, talk about these questions.

1 Why is it important for salespeople to understand their products?

2 How can engineers help sell products?

Reading

2 Read this email from an engineering company owner to one of his engineers. Then, choose the correct answers.

1 What is the main topic of the email?

A a meeting with a potential client
B reasons why new clients are needed
C technical details of an MP3 player
D the benefits of a client's new product

2 Which of the following will the engineer NOT do?

A consult with the new client
B show the value of updated hardware
C aid a company's marketing department
D design new types of consumer goods

3 What will the engineer do if she is successful?

A Earn a financial bonus.
B Receive a promotion.
C Join the marketing department.
D Modify an advertising campaign.

From: greghanson@hansondesign.co.uk
To: katietempleton@hansondesign.co.uk
Subject: New Client

Katie,

I need you to contact Kurt Smith at Sandia Manufacturing – a potential new client. The company manufactures **technological** consumer goods. After doing market research, Kurt decided to **modify** the hardware on one of their outdated MP3 players. Our engineers can help Sandia Manufacturing do this.

Since you've never been a **liaison** to a potential client, I'd like to go over some basics with you. When you **consult** with them, **demonstrate** how beneficial our faster coder/decoder chip and greater on-chip memory capacity would be for them. I know you have the **expertise** to help them understand all of the **technical** aspects involved. They need to know that our hardware is better than our **competitors**'.

If they become a client, you'll receive the **commission**. Also, Sandia Manufacturing's **marketing** department will contact you. They'll need help understanding the technical details for their **advertising** campaign.

Good luck!
Greg

Vocabulary

3 Match the words (1-6) with the definitions (A-F).

1 __ demonstrate
2 __ technological
3 __ consult
4 __ modify
5 __ advertising
6 __ technical

A related to science and technology
B to show how something works
C to give professional or expert advice
D pertaining to a specific skill, art, or science
E the process of drawing attention to products
F to change something

4 Use the words from the word bank to fill in the blanks.

word BANK

commission marketing competitors
expertise liaison market research

1 _____ shows what consumers want.
2 Lower prices take business away from _____.
3 Employees get a(n) _____ for signing new accounts.
4 _____ in computers is a valuable quality.
5 The _____ department created a new commercial.
6 Mr. Ames is a _____ between the engineers and clients.

5 Listen and read the email. How is Hanson design's hardware better than their competitors?

Listening

6 Listen to a conversation between a sales engineer and a potential client. Mark the following statements as true (T) or false (F).

1 __ The woman's company makes several MP3 players.
2 __ The woman's company does not produce hardware.
3 __ The data storage system is the fastest one available.

7 Listen again and complete the conversation.

Engineer: Good morning, sir.
Client: Good morning. Thanks for coming in.
Engineer: My pleasure. So, can you tell me a little bit about your company's needs?
Client: We sell a fairly wide range of MP3 players, and one of our older products needs to be updated.
Engineer: I see. And you're looking to **1** _____ the firmware on that item, correct?
Client: That's right. We don't make our own data retrieval system.
Engineer: Well, our engineers are more than **2** _____ _____ _____ you with that.
Client: Okay. So what can you offer that your **3** _____ can't?
Engineer: Our new data retrieval system is faster than anything on the market.
Client: Really? That sounds interesting. **4** _____ _____?
Engineer: Of course. I can help your **5** _____ team convey that idea of speed in your **6** _____.

Speaking

8 With a partner, act out the roles below, based on task 7. Then switch roles.

USE LANGUAGE SUCH AS:

Why don't you tell me a little bit about ...?

So what can you offer that your competitors can't?

Our new ... is ... than anything on the market.

Student A: You talking to a sales engineer. Ask Student B:

- what is offered
- competition
- marketing

Student B: You are a sales engineer. Answer Student A's questions.

Writing

9 Use the conversation from Task 8 to write a letter to the potential new client thanking them for their time. Write about why the client should buy your company's product.

Hanson DESIGN

Dear _____

Thank you so much for

_____

_____

_____

Sincerely,

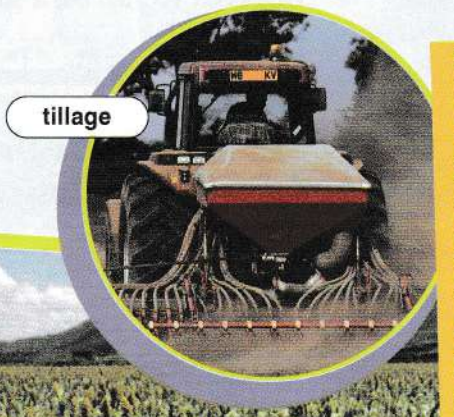
_____

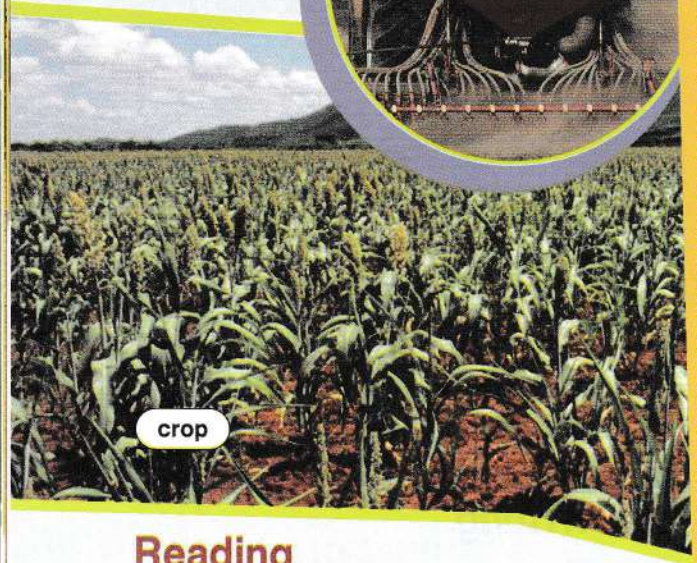
12 Agricultural engineering

Get ready!

1 Before you read the passage, talk about these questions.

1 What do agricultural engineers do?
2 Why is agricultural engineering important?





Plant Co

PLANT CO OFFERS AGRICULTURE SOLUTIONS

In this age of modern **agriculture**, your **crops** should never fail to meet your expectations. That's why PlantCo is offering its agricultural engineering skills.

PlantCo can help you grow crops from the ground up, starting with our state-of-the-art **tillage** services. We prepare your soil for the exact crop you want.

We can evaluate your **water rights** as well as test the water's **hydrology** and **salinity**.

Depending on the location and the plant, we provide many **irrigation** methods. We offer **flood-irrigation** for your grains like wheat and rice. Choose **localized irrigation** for plants that need the most attention. We also offer **pivot-irrigation**. These systems assure a high **distribution uniformity** – you can be sure that your plants will be evenly watered. We also provide expert **drainage** services to keep your land well-drained and free of excess water.

We know your crops are important to you. And at PlantCo, we make sure they grow up right.

Reading

2 Read this advertisement from an agricultural engineering firm. Then, choose the correct answers.

1 What is the advertisement mainly about?
- **A** what services the firm offers
- **B** selling seeds for different crops
- **C** how to choose an agricultural service
- **D** appropriate salinity levels for crops

2 Which of the following is true?
- **A** Pivot-irrigation is a new service.
- **B** PlantCo checks water salt levels.
- **C** Flood-irrigation is the most effective.
- **D** PlantCo sells water rights to customers.

3 What can you infer from the advertisement?
- **A** PlantCo is a new company.
- **B** Farmers access to water is controlled.
- **C** Farmers can buy land from PlantCo.
- **D** Drainage is more expensive than tillage.

Vocabulary

3 Match the words (1-7) with the definitions (A-G).

1 __ crops
2 __ pivot-irrigation
3 __ flood-irrigation
4 __ hydrology
5 __ salinity
6 __ agriculture
7 __ localized irrigation

- **A** covering an entire area with water
- **B** the amount of salt in something
- **C** the science of farming
- **D** water applied to crops in specific areas
- **E** water applied in a circular motion to crops
- **F** plants that are grown and sold for profit
- **G** the study of water

4 **Use the words from the word bank to fill in the blanks.**

WORD BANK

irrigation tillage distribution uniformity
water rights drainage

1 _____ prepares soil to support crops.
2 _____ moves water away from an area.
3 _____ assures that all crops are watered evenly.
4 A farmer's access to water depends on _____.
5 Farmers set up _____ systems to water crops.

5 **Listen and read the advertisement. How many types of irrigation do PlantCo offer?**

Listening

6 **Listen to a conversation between a customer and an agricultural engineer. Mark the following statements as true (T) or false (F).**

1 __ The engineer suggests localized irrigation.
2 __ Pivot irrigation can cause flooding.
3 __ The customer purchases the draining service.

7 **Listen again and complete the conversation.**

Engineer: This is PlantCo. My name is May. How can I help you?
Customer: Hi, May. I'm having trouble with my crops.
Engineer: Okay. I can help you with that. What kind of plant are you growing?
Customer: Right now I'm growing tomato plants.
Engineer: Okay, in that case I recommend a **1** _____ _____ system.
Customer: I don't know. I hear that can get a bit expensive.
Engineer: It's actually a worthwhile investment with a **2** _____ _____ like tomatoes.
Customer: I'm **3** _____ _____ _____. Are there any other options?
Engineer: **4** _____ - _____ is also an option. It sprays water around in a circular motion.
Customer: I don't think that's a good idea. Tomatoes are sensitive to **5** _____ and soggy soil.
Engineer: Yes, that can happen with pivot-irrigation. But if you use our **6** _____ _____, we can get rid of the excess.

Speaking

8 **With a partner, act out the roles below, based on task 7. Then switch roles.**

USE LANGUAGE SUCH AS:

I'm having trouble with ...
Tomatoes are sensitive to flooding.
Are there any other options?

Student A: You need a new irrigation system. Talk to Student B about:

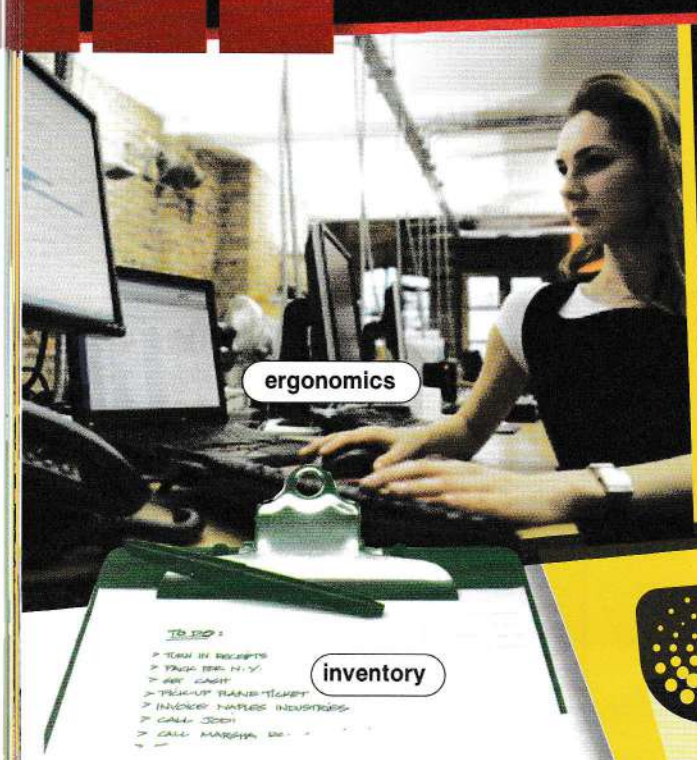
- irrigation options
- cost
- flooding

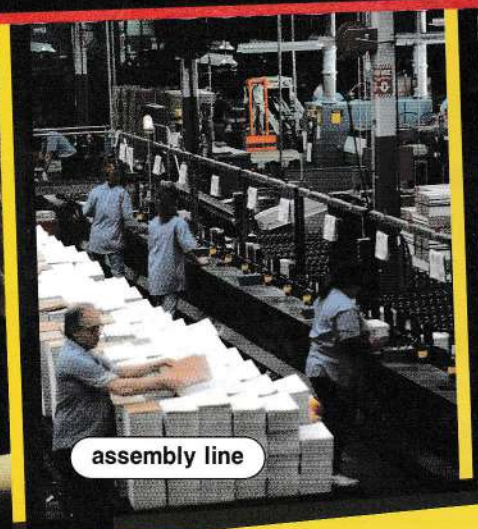
Student B: You are an agricultural engineer. Answer Student A's questions.

Writing

9 **Use the advertisement and the conversation from Task 8 to write a follow up email to the customer (100-120 words). Be sure to write about irrigation options and expenses.**

13 Industrial engineering





Get ready!

1 Before you read the passage, talk about these questions.

1 What kind of fields do industrial engineers work in?

2 What type of problems do industrial engineers solve?

Reading

2 Read this report from an industrial engineer. Then, choose the correct answers.

1 What is the report mostly about?

A the facility layout of Turbo's factory
B the efficiency of the factory's operations
C the reasons for building a new factory
D the importance of high productivity

2 What aspect of the factory needs improvement?

A inventory planning
B quality control
C positioning of equipment
D the facility's leadership

3 What will making the changes NOT do?

A enhance the workers' efficiency
B raise a key quality rating
C improve transportation logistics
D increase the plant's potential output

TURBO MOTOR COMPANY

Operations Report

This report examines the efficiency of Turbo's factory. It looks at all channels of the **supply chain**.

Turbo's daily operations are efficient in many areas. The **facility layout** uses space well. Workers manage **inventory** planning without a problem. They appear to handle transportation **logistics** smoothly. There are no apparent issues with **quality control** either.

But the factory is not as **cost-effective** as possible. Making small changes can increase productivity. For example, I recommend improving the workstation **ergonomics**. One way to do this is to raise the **conveyor**. Altering the arrangement of the **assembly line** is another idea. Making such changes will help to enhance worker efficiency.

These modifications will increase work **capacity**. They will help to **streamline** the production process as a whole. I suggest making these changes as soon as possible.

Vocabulary

3 Match the words (1-6) with the definitions (A-F).

1 __ supply chain
2 __ facility layout
3 __ assembly line
4 __ streamline
5 __ cost-effective
6 __ logistics

A the arrangement of a factory's workspace
B to make an operation more efficient
C worth the money spent
D the steps in moving a product from supplier to customer
E the organization of an operation
F a line of workers or machines in a factory

4 Choose the word that is closest in meaning to the underlined part.

1 Designing comfortable equipment reduces injuries.
A logistics **B** ergonomics **C** capacity

2 The equipment that moves materials is broken.
A conveyor **B** assembly line **C** supply chain

3 Amy manages ensuring quality and safety.
A ergonomics **B** capacity **C** quality control

4 Update the list of materials and goods.
A supply chain **B** conveyor **C** inventory

5 What is the production maximum amount?
A facility layout **B** capacity **C** quality control

5 Listen and read the report. How can the factory be changed to help the workers produce more?

Listening

6 Listen to a conversation between an engineer and Turbo Motor Co.'s owner. Mark the following statements as true (T) or false (F).

1 __ The woman has ideas to increase productivity.
2 __ Altering the assembly line is the cheaper option.
3 __ Raising the conveyor will slow the assembly line.

7 Listen again and complete the conversation.

Owner: The first option seems less expensive, doesn't it?
Engineer: Yes, and it's **1** _____ _____. One quick fix is to raise the conveyor.
Owner: What exactly will that do?
Engineer: It will help **2** _____ _____ on your workers. Some of them **3** _____ _____ back pain.
Owner: Well, how high do you suggest raising it?
Engineer: **4** _____ _____. Even a few inches will help.
Owner: And **5** _____ _____ _____ this will increase our productivity?
Engineer: Yes. It would enhance the workers' efficiency. And **6** _____ _____ their pace on the assembly line.

Speaking

8 With a partner, act out the roles below, based on task 7. Then switch roles.

USE LANGUAGE SUCH AS:
What exactly will that do?
How high do you suggest raising it?
It would enhance the workers' efficiency.

Student A: You want to make your factory more efficient. Ask Student B about:
- increasing efficiency
- costs of changes
- details of changes

Student B: You are an industrial engineer. Answer Student A's questions.

Writing

9 Use the report and the conversation from Task 8 to complete the owner's notes.

Improving Productivity

Suggestions: _____

_____ or _____

Raising conveyor will:

Reduce _____

Enhance _____

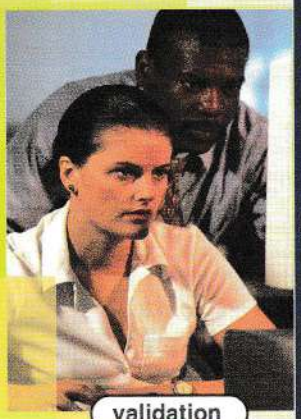
Speed up _____

14 Software engineering

Get ready!

1 Before you read the passage, talk about these questions.

1 What does a software engineer do?
2 How do people become software engineers?


validation

Tech Monthly Issue 19

SOFTWARE ENGINEERING VS. COMPUTER SCIENCE

by Jason Rose

At first glance, **software engineering** and **computer science** might seem very similar. But actually, these disciplines are very different.

Computer science is very broad – it deals with the interaction of hardware and software. Software engineering is more specialized. Software engineers do more than just work on software **development.** They also focus on its **design** and **operation**. Software engineers go to great lengths to ensure a program's **quality.**

Once a project is designed, software engineers must **assess** it. **Testing** makes sure that the software works. **Problem modeling** analyzes the program for potential issues. The process of **verification** enforces its design specifications, and **validation** makes sure that the software is user-friendly.

But an engineer's work is not done when the product is released. The engineers will also do **maintenance** to fix any remaining problems.

So even though they are related disciplines, a software engineer works with a software product more than a computer science professional.

Reading

2 Read this column from Tech Monthly. Then, choose the correct answers.

1 What is the column about?
- A what software engineers do
- B the limits of computer science
- C choosing a career in computers
- D software and hardware differences

2 What is the purpose of verification?
- A It ensures that software works.
- B It checks software for ease of use.
- C It fixes problems after a product's release.
- D It ensures that software meets guidelines.

3 What process assures that software is easy to use?
- A problem modeling
- B verification
- C validation
- D maintenance

Vocabulary

3 Match the words (1-9) with the definitions (A-I).

1 __ assess
2 __ development
3 __ software engineering
4 __ design
5 __ computer science
6 __ problem modeling
7 __ validation
8 __ operation
9 __ maintenance

- A to evaluate
- B engineering that focuses on software creation
- C the structure of a software program
- D checking for issues
- E the entire process of building software
- F the repair of software after its release
- G engineering that focuses on computer maintenance
- H the process of checking software's user-friendliness
- I the actual use of a software program

4 **Use the words from the word bank to fill in the blanks.**

WORD BANK

testing quality verification

1 Software engineers assess software's _____.
2 _____ checks for all types of errors.
3 _____ ensures that programs meet specifications.

5 **Listen and read the column. How are software engineering and computer science different?**

Listening

6 **Listen to a conversation between a manager and a software engineer. Mark the following statements as true (T) or false (F).**

1 __ The program has not reached the testing phase.
2 __ Verification of the program is complete.
3 __ The engineer will check for file formatting issues next.

7 **Listen again and complete the conversation.**

Manager: Good morning, Martin. How is the Image Suite project going?
Engineer: It's going well, Ms. Donald. It's a very powerful program.
Manager: What phase are you in?
Engineer: We're currently testing the program.
Manager: So you're **1** _____ the software's functionality?
Engineer: Yes. The software is conforming to the operational **2** _____ of its design very well.
Manager: **3** _____ _____. So what are the specific functions you're testing?
Engineer: Right now we're just testing all the different brushes and tools to make sure they work correctly.
Manager: And things are going well? **4** _____ _____ _____?
Engineer: **5** _____ _____ _____. Next up we're going to verify that images can be stored and retrieved in different formats.
Manager: What are you looking for?
Engineer: We need to see how it saves images in **6** _____ _____ _____ to ensure the image can be consistently reproduced in any layout.

Speaking

8 **With a partner, act out the roles below, based on task 7. Then switch roles.**

USE LANGUAGE SUCH AS:

What phase are you in?
We're currently ...
What are you testing now?

Student A: You are a supervisor. And you want to know about the project. Ask Student B questions to find out about:

- verification
- testing
- problems

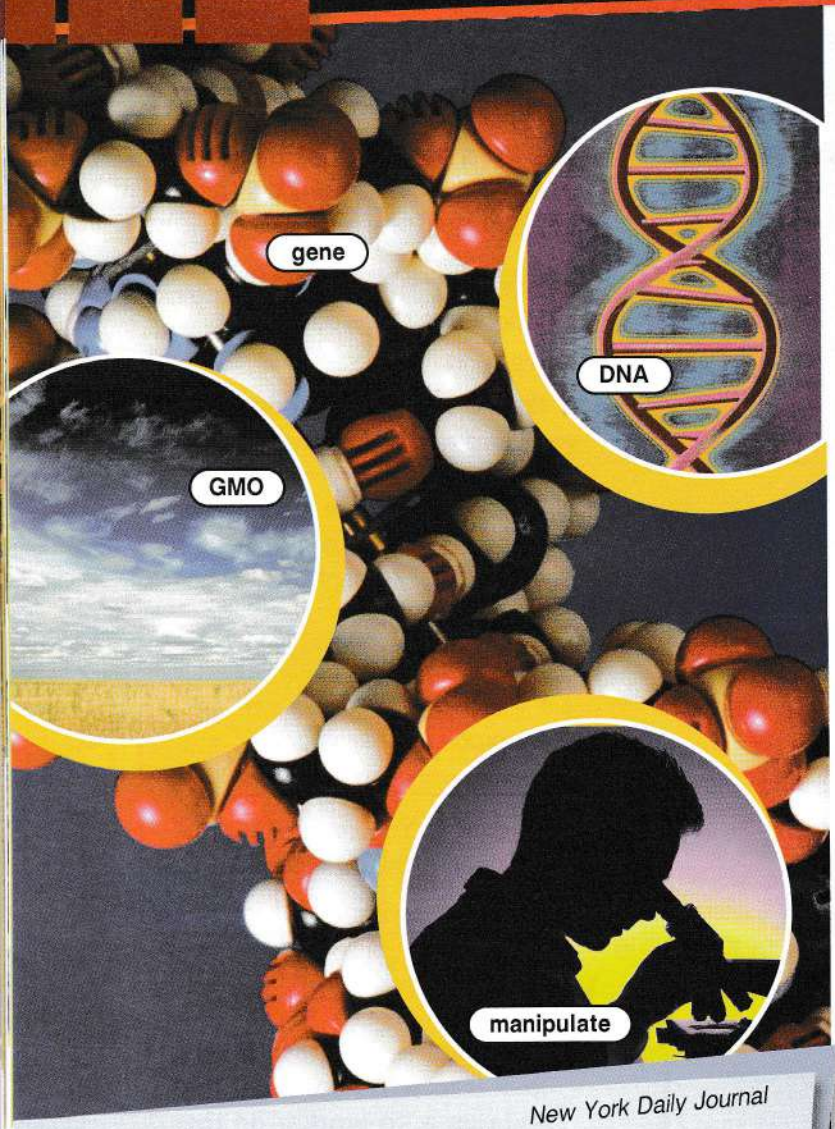
Student B: You are a software engineer. Answer Student A's questions.

Writing

9 **Use the conversation from Task 8 to write an email that updates a co-worker on the project. Be sure to write about testing and problem modeling.**

From: _____
To: _____
Subject: _____

15 Genetic engineering



Get ready!

1 Before you read the passage, talk about these questions.

1 Why is genetic engineering important to understand?

2 Will genetic engineering help or hurt people? Why?

Reading

2 Read this newspaper article. Then, choose the correct answers.

1 What is the article mostly about?

A a method of reducing beta-carotene levels
B a research study on GMOs
C a new type of vitamin-rich food
D a group opposed to GMOs

2 What is used to identify the successfully modified rice?

A a DNA probe
B a vector
C molecular cloning
D manipulated genes

3 What can be inferred about *Golden Rice*?

A It is currently only consumed by animals.
B It is the same color as common rice.
C It has made some people sick.
D It is not produced on a large scale yet.

Vocabulary

3 Match the words (1-7) with the definitions (A-G).

1 __ DNA
2 __ vector
3 __ deficiency
4 __ GMO
5 __ expression
6 __ trait
7 __ manipulate

A a gene causing a characteristic
B something used to transfer genetic material
C a part of chromosomes that holds genetic material
D an organism that has undergone genetic changes
E a lack of a something necessary
F to change or influence something
G a distinguishing characteristic

New York Daily Journal

GOLDEN RICE: THE PROCESS & THE PROBLEM

NEW YORK - A controversy is brewing over the **GMO** (Genetically Modified Organism) *Golden Rice*. This rice is created by **manipulating** the **genes** in the **DNA** of common rice. Several steps are involved. First, the desirable gene is obtained through **molecular cloning**. For *Golden Rice*, this is beta-carotene, an organic compound. Next, the beta-carotene is put into a **vector** that transfers it into the organism being modified. This causes the **transformation** of the rice's cells. Then, a **DNA probe** is used to **select** the successfully modified rice. Finally, the **expression** of the desired **trait** can be seen. For *Golden Rice*, this is a high level of beta-carotene.

Why go through all this? Because beta-carotene is a form of Vitamin A. *Golden Rice* could save millions of lives in countries with Vitamin A **deficiencies**. The controversy, however, lies with the possible environmental and health risks that may or may not come from GMOs. Until more research is done, many groups will oppose the widespread growth of *Golden Rice*.

4 Write a word that is similar in meaning to the underlined part.

1 The organism went through a <u>change</u>.
t _ _ _ s _ _ _ m _ _ _ o _

2 <u>Choose</u> the modified rice next.
s _ l _ _ t

3 Jon is studying the <u>section of DNA</u> that determines height.
_ _ ne

4 Some oppose <u>the process of copying genes</u>.
_ _ l _ _ _ l _ _ c _ _ n _ _ g

5 Use a <u>DNA fragment that finds manipulated genes</u>.
_ _ A _ _ o _ e

5 Listen and read the article. Why are many groups opposed to the widespread growth of *Golden Rice*?

Listening

6 Listen to an interview between a reporter and a genetic engineer. Mark the following statements as true (T) or false (F).

1 __ The woman explains how types of rice differ.
2 __ *Golden Rice* has led to the use of more GMOs.
3 __ The engineer transform cells with DNA probes.

7 Listen again and complete the conversation.

Reporter: Would you mind telling us more about the **1** _____ _____ *Golden Rice* and normal rice?
Engineer: Well, the difference basically lies within their **2** _____ .
Reporter: I see. And you **3** _____ that, correct?
Engineer: Yes, we **4** _____ the beta-carotene **5** _____ into the common rice that we're modifying.
Reporter: How do you do that?
Engineer: We **6** _____ _____ to transform the cells of common rice. The result is Golden Rice.
Reporter: Aren't you worried about the fact that it's a **7** _____?
Engineer: I actually think GMOs are quite safe.

Speaking

8 With a partner, act out the roles below, based on task 7. Then switch roles.

USE LANGUAGE SUCH AS:

Well, the difference basically lies ...
How do you do that?
Aren't you worried about the fact that ...?

Student A: You are a reporter interested in a GMO. Ask Student B about:

- differences
- how it is made
- benefits

Student B: You are a genetic engineer. Answer Student A's questions.

Writing

9 Use the conversation from Task 7 to write a short summary of the interview about a GMO. Be sure to include why it is different from common rice as well as its benefits.

GMO
Interview Summary

Genetic Engineer Name: _____

How Golden Rice is different:

_____

_____

Benefits of Golden Rice:

_____

_____

_____

Glossary

ABET [N-UNCOUNT-U3] The **American Board for Engineering and Technology (ABET)** is the governing body that grants accreditation to university engineering degree programs in the United States.

abstract [ADJ-U6] Something that is **abstract** can generally exist only as an idea. It is the opposite of "concrete."

accredited [ADJ-U3] Something that is **accredited** has been officially recognized by a governing body as meeting certain basic requirements.

advertising [N-UNCOUNT-U11] **Advertising** is the process of calling consumers' attention to a company's products or services.

agriculture [N-UNCOUNT-U12] **Agriculture** is the science of farming.

analysis [N-COUNT-U5] **Analysis** is the act of closely examining something.

application [N-COUNT-U5] **Application** is the act of putting an idea into practice.

approach [N-COUNT-U5] An **approach** is how you deal with something.

assembly line [N-COUNT-U13] An **assembly line** is a line of workers or machines in a factory working on a product. A worker performs a job and then the product moves to the next worker.

assess [V-TRANS-U14] To **assess** something is to evaluate it.

attack [V-TRANS-U5] To **attack** something is to attempt to solve it.

axis [N-COUNT-U7] An **axis** is the line on a graph that shows a point's position.

bachelor's degree [N-COUNT-U3] A **bachelor's degree** is an undergraduate degree that is awarded upon completion of a course of study that typically lasts four years.

bar graph [N-COUNT-U7] A **bar graph** is a chart that uses rectangles of different lengths to show amounts.

blueprint [N-COUNT-U8] A **blueprint** is a plan for building something.

body language [N-UNCOUNT-U4] **Body language** refers to communication through body movements instead of speaking.

brittle [ADJ-U9] A **brittle** material will break easily under pressure.

calculation [N-COUNT-U10] A **calculation** is a function of mathematics wherein numbers are manipulated to achieve a result. Calculations can include addition, subtraction, multiplication, division, and other operations.

capacity [N-UNCOUNT-U13] **Capacity** refers to the maximum amount of work a company or organization can perform.

catapult [N-COUNT-U1] A **catapult** is a device designed to throw objects long distances without the use of explosives such as gunpowder.

citation [N-COUNT-U4] A **citation** is a reference to a piece of writing.

commission [N-COUNT-U11] A **commission** is a payment made to a sales agent in return for securing a sale or other business relationship.

common sense [N-UNCOUNT-U2] **Common sense** is practical knowledge.

competence [N-UNCOUNT-U2] **Competence** is a person's ability to do something as it should be done.

competitor [N-COUNT-U11] A **competitor** is a rival company that creates similar products and is competing for the same consumers.

comprehension [N-UNCOUNT-U5] **Comprehension** is the step of a problem solving method in which data and theory combine to solve a problem.

computer science [N-UNCOUNT-U14] **Computer science** is the study of how computers can be used.

concrete [ADJ-U6] Something that is **concrete** either currently exists in reality or could exist in reality. It is the opposite of "abstract."

conductor [N-COUNT-U9] A **conductor** is a material that lets electricity or heat pass through it.

consult [V-T-U11] To **consult** with someone is to give them professional or expert advice.

convention [N-COUNT-U10] A **convention** is a method or practice established through widespread or common use.

convention [N-COUNT-U6] A **convention** is something that is the subject of general agreement or consent.

conveyor [N-COUNT-U13] A **conveyor** is a piece of equipment that moves materials in a line from one area to another.

coordinate [N-COUNT-U7] A **coordinate** is a pair of numbers that show position on a graph.

cost-effective [ADJ-U13] Something that is **cost-effective** is worth the amount of money you spent on it.

counterweight [N-COUNT-U1] A **counterweight** is a heavy object that is used to balance some type of load. In trebuchets, it is the weight that causes the sling to rotate around the pivot and launch the projectile.

courage [N-UNCOUNT-U2] When you have **courage** you are brave enough to do something.

creative [ADJ-U6] Something that is **creative** is the result of unique and different thought or expression.

crop [N-COUNT-U12] A **crop** is a group of plants that you grow in order to eat or sell.

cross-section [N-COUNT-U8] A **cross-section** is a drawing of something cut in half to reveal the inside of it.

cue card [N-COUNT-U4] A **cue card** is a card with information that helps a person remember what to say.

curiosity [N-UNCOUNT-U2] **Curiosity** is an interest in learning something.

deficiency [N-COUNT-U15] A **deficiency** is a lack of a necessary nutrient or other desirable item.

degree [N-COUNT-U2] A **degree** is an academic qualification completed at a college.

demonstrate [V-I-U11] To **demonstrate** something is to show another person how it works.

dependability [N-UNCOUNT-U2] **Dependability** is the ability for people to trust you to do things.

dependent variable [N-COUNT-U7] A **dependent variable** is a number that depends on the value of another part of a mathematical equation.

depth [N-COUNT-U8] **Depth** is how deep something is.

design [N-COUNT-U14] The **design** of software is its planning and structure.

development [N-UNCOUNT-U14] **Development** is the act of actually making software.

diagram [N-COUNT-U8] A **diagram** is a drawn plan for something.

digit [N-COUNT-U10] A **digit** is a number.

dimension [N-COUNT-U8] A **dimension** is the size of something.

distribution uniformity [N-UNCOUNT-U12] **Distribution uniformity** is a percentage of how equally water is being applied to an area.

DNA [N-UNCOUNT-U15] **DNA** is a main component of chromosomes. It transfers genetic material in all living organisms.

DNA probe [N-COUNT-U15] A **DNA probe** is a fragment of DNA that is used to detect a manipulated gene.

doctorate [N-COUNT-U3] A **doctorate** is a postgraduate degree that typically represents the highest possible level of study in a particular field. It is achieved through several years of study beyond an initial undergraduate degree.

drainage [N-UNCOUNT-U12] **Drainage** is the removal of excess water.

ductility [N-UNCOUNT-U9] **Ductility** refers to a material's ability to not break under tensile force.

EAB [N-UNCOUNT-U3] The **Engineering Accreditation Board (EAB)** is the governing body that grants accreditation to university engineering degree programs in the United Kingdom.

entry-level [ADJ-U3] Something that is **entry-level** is related to low-level job positions wherein new university graduates can gain experience and skills.

Glossary

ergonomics [N-UNCOUNT-U13] **Ergonomics** is the science of designing equipment and workspaces that benefit and aid the worker.

expertise [N-UNCOUNT-U11] **Expertise** is a high level of skill or knowledge on a certain topic or subject.

exploded view [N-COUNT-U8] An **exploded view** is a drawing that shows how different parts of something fit together by drawing the parts separately.

expression [N-UNCOUNT-U15] **Expression** is the action of a gene that is showing a certain distinguishing characteristic.

facility layout [N-UNCOUNT-U13] **Facility layout** refers to the design and arrangement of a factory's workspace.

feedback [N-UNCOUNT-U6] **Feedback** is a reaction to an object or activity. It usually includes opinions on how the object or activity can be improved.

flood-irrigation [N-UNCOUNT-U12] **Flood irrigation** covers an entire area with water.

gene [N-COUNT-U15] A **gene** is a section of DNA which contains the information that determines physical characteristics.

general-to-specific strategy [N-COUNT-U4] A **general-to-specific strategy** is a way of organizing information so that you discuss general ideas first and then specific details.

geometry [N-COUNT-U8] **Geometry** is the mathematical shape and arrangement of an object.

GMO [N-COUNT-U15] A **genetically modified organism (GMO)** is an organism whose genetic material has been changed. Both plants and animals can be GMOs.

graph [N-COUNT-U7] A **graph** is a diagram showing a relationship between variables.

handout [N-COUNT-U4] A **handout** is a document that you distribute to people during class or a presentation.

hardness [N-UNCOUNT-U9] **Hardness** is a property that makes an object difficult to dent or break.

hydrology [N-UNCOUNT-U12] **Hydrology** is the study of water.

independent variable [N-COUNT-U7] An **independent variable** is a number that does not depend on the value of another part of a mathematical equation.

innovation [N-UNCOUNT-U6] **Innovation** is the act of coming up with new and different ideas.

insulator [N-COUNT-U9] An **insulator** is a material that prevents heat or electricity from passing through it.

integer [N-COUNT-U10] An **integer** is any positive or negative whole number, including zero.

interpersonal [ADJ-U2] When something is **interpersonal** it is between people.

inventory [N-COUNT-U13] An **inventory** is a list of the materials and goods in a factory.

irrigation [N-UNCOUNT-U12] **Irrigation** is the supplying of water to crops.

iteration [N-COUNT-U5] An **iteration** is an instance of doing something repeatedly.

iterative procedure [N-COUNT-U5] An **iterative procedure** is the act of doing something over and over with slight changes until you perfect it.

KISS [V PHRASE-U4] **KISS** (Keep It Short and Simple) is a principle that reminds a person to present or do something in the simplest way.

leading zero [N-COUNT-U10] A **leading zero** is a zero that leads a number string.

length [N-COUNT-U8] **Length** is how long something is.

liaison [N-COUNT-U11] A **liaison** is a person who creates and maintains contact between two groups in order to ensure collective action or cooperation.

line graph [N-COUNT-U7] A **line graph** is a chart showing points connected by straight lines.

localized irrigation [N-UNCOUNT-U12] **Localized irrigation** applies small amounts of water directly to plants.

logic [N-UNCOUNT-U5] **Logic** is a reasonable way of thinking.

logistics [N-COUNT-U9] **Logistics** refer to the organizing of an operation or process so that it happens efficiently.

long-term [ADJ-U2] When something is **long-term** it happens for a long time.

luster [N-UNCOUNT-U9] **Luster** refers to the brightness or shine of a metal.

maintenance [N-UNCOUNT-U14] **Maintenance** is fixing a software's flaws after it is released.

malleable [ADJ-U9] A **malleable** material bends easily when you press it.

manipulate [V-I-U15] To **manipulate** something is to change or influence it.

market research [N-UNCOUNT-U11] **Market research** is the process of surveying the public to gain information about consumer tastes or preferences.

marketing [N-UNCOUNT-U11] **Marketing** includes all the activities that a company undertakes in order to advertise, sell, and deliver a product to consumers.

mass [N-UNCOUNT-U1] **Mass** determines the degree to which a body creates or is affected by a gravitational field. In everyday usage, it is usually equated with the word "weight." In scientific usage, however, it can be used to refer to several different properties.

master's degree [N-COUNT-U3] A **master's degree** is a postgraduate degree that is awarded to people who have developed a level of mastery over a particular field. It is achieved through one or more additional years of study beyond an initial undergraduate degree.

mechanical advantage [N-UNCOUNT-U1] **Mechanical advantage** is the factor by which a machine or mechanism multiplies the force that is being applied to it.

MEng [N-COUNT-U3] The **Master's of Engineering (MEng)** is a master's degree in the field of engineering.

Middle Ages [N-UNCOUNT-U1] The **Middle Ages** is a period of history that extends from the 5th century through the 15th century.

modify [V-I-U11] To **modify** something is to alter or change the qualities of it in order to make it better.

molecular cloning [N-UNCOUNT-U15] **Molecular cloning** is the process of copying genes.

MSc [N-COUNT-U3] The **Master's of Science (MSc)** is a master's degree in a scientific field.

MSc(Res) [N-COUNT-U3] The **Master's of Science by Research (MSc[Res])** is a master's degree in a scientific field that is achieved primarily through research instead of classroom instruction.

natural [ADJ-U9] **Natural** materials come from nature. Glass, stone, and wood are some examples.

norm [N-COUNT-U6] A **norm** is a standard or commonly-held notion.

notation [N-COUNT-U10] In mathematics, a **notation** is a system of representing mathematical objects or ideas. Numbers and function symbols are examples of notations.

objective [N-COUNT-U4] An **objective** is the main goal that a person aims to achieve.

operation [N-UNCOUNT-U14] **Operation** is use of software.

order of magnitude [N-COUNT-U10] An **order of magnitude** is the class of scale of any amount. It usually contains a value that is of a certain ratio to the class preceding it. For example, 0.1 is one order of magnitude greater than 0.01, and 1 is one order of magnitude greater than 0.1.

organization [N-UNCOUNT-U2] **Organization** is the ability to plan and put things together in an orderly fashion.

originality [N-UNCOUNT-U6] **Originality** is the quality of being independent, new, and unique.

out of the box [ADJ-PHRASE-U6] Something that is **out of the box** is outside the realm of conventional thought or practice. Could also be expressed as "outside the box."

payload [N-COUNT-U1] A **payload** is an object or quantity to be sent or thrown.

perimeter [N-COUNT-U8] **Perimeter** is the length of something's outer edges.

Glossary

PhD [N-COUNT-U3] The **Doctor of Philosophy (PhD)** is a doctorate that can be achieved in a variety of fields.

pivot [N-COUNT-U1] A **pivot** is the object around which other objects rotate or turn.

pivot-irrigation [N-UNCOUNT-U12] **Pivot-irrigation** involves a machine that rotates, applying water to a circular area around the machine.

plastics [N-COUNT-U9] **Plastics** are synthetic materials that one can shape into many different forms.

plausible [ADJ-U6] Something that is **plausible** seems reasonable or achievable.

postgraduate degree [N-COUNT-U3] A **postgraduate degree** is any degree that is awarded upon completion of additional years of study beyond the initial undergraduate degree. Master's degrees and doctorates are examples of postgraduate degrees.

presentation program [N-COUNT-U4] A **presentation program** is a computer program that lets you display information in a slide show.

problem identification [N-COUNT-U5] **Problem identification** is the act of stating what issues one must address in a situation.

problem modeling [N-UNCOUNT-U14] **Problem modeling** is the assessment of software for issues.

problem solving [N-UNCOUNT-U2] **Problem solving** is the act of resolving issues and finding solutions.

projectile [N-COUNT-U1] A **projectile** is an object that is being launched or thrown through the air.

projector [N-COUNT-U4] A **projector** is a machine that lets you show images on a screen or surface.

quality [N-COUNT-U2] A **quality** is a feature that someone or something has.

quality [N-UNCOUNT-U14] **Quality** is how well software is designed.

quality control [N-UNCOUNT-U13] **Quality control** refers to the activities one performs to ensure a product's quality and safety.

quantitative thinking [N-UNCOUNT-U2] **Quantitative thinking** is the ability to think in terms of numbers.

quantity [N-COUNT-U10] A **quantity** is an amount of something. It can be either precise or indefinite.

redefine [V-TRANS-U5] To **redefine** something is to state it again in a different manner.

rounding error [N-COUNT-U10] A **rounding error** is a miscalculation that results from improperly rounding a number to a convenient number of decimals.

salinity [N-UNCOUNT-U12] **Salinity** is the amount of salt in something.

scale [N-COUNT-U8] **Scale** is the relationship between the size of something drawn and its real size.

scatter plot [N-COUNT-U7] A **scatter plot** is a chart with many points on it to show relationships between two variables.

schematic [N-COUNT-U8] A **schematic** shows the form and features of something.

scientific notation [N-UNCOUNT-U10] **Scientific notation** is a way of easily expressing very large or very small quantities. It incorporates the use of superscript digits. $3x10^6$, for example, is 3,000,000 written in scientific notation.

select [V-I-U15] To **select** something is to choose it.

siege engine [N-COUNT-U1] A **siege engine** is a device that was used in the Middle Ages to destroy castle walls, city walls, or other fortifications during a siege.

significant figure [N-COUNT-U10] A **significant figure** is a digit that helps identify a number's precision. All numbers are significant except for leading and trailing zeros when they serve as placeholders, or digits that are introduced as a result of calculations that are carried out to more decimal places than the original numbers.

signpost [N-COUNT-U4] A **signpost** is a phrase or word that helps signal the different parts of a presentation to the audience.

sling [N-COUNT-U1] A **sling** is a device that holds and, when subjected to the proper forces, launches or throws a projectile.

software engineering [N-UNCOUNT-U14] **Software engineering** is a profession that develops and improves computer programs.

solution [N-COUNT-U5] A **solution** is an answer to a problem.

streamline [V-T-U13] To **streamline** an operation is to improve it and make it more efficient.

summarize [V-T-U4] To **summarize** something is to briefly repeat its main points.

supply chain [N-COUNT-U13] A **supply chain** consists of all the people and resources that help get a product from a supplier to a customer.

synthesis [N-COUNT-U5] A **synthesis** is a mixture of ideas.

synthetic [ADJ-U9] **Synthetic** materials are artificial, man-made substances.

technical [ADJ-U11] If something is **technical**, it relates to a specific skill, art, or science.

technological [ADJ-U11] If something is **technological**, it is related to science and technology.

tensile [ADJ-U9] A **tensile** material is able to stretch easily.

testing [N-UNCOUNT-U14] **Testing** is the act of making sure software works.

tillage [N-UNCOUNT-U12] **Tillage** is the preparing of soil for crops.

torque [N-UNCOUNT-U1] **Torque** is a measure of the turning force being placed upon an object.

trailing zero [N-COUNT-U10] A **trailing zero** is a zero that occurs in the decimal representation of a number. No other digits follow a trailing zero (or a series of trailing zeros), and they are always considered significant.

trait [N-COUNT-U15] A **trait** is a distinguishing characteristic.

transformation [N-UNCOUNT-U15] **Transformation** is the process of changing in appearance, form, nature, or character.

transparent [ADJ-U9] A **transparent** material is clear and easy to see through.

trebuchet [N-COUNT-U1] A **trebuchet** is a weapon that was popular during the Middle Ages. It was often used to launch rocks and other items into to walls of the fort or castle that was being attacked.

undergraduate degree [N-COUNT-U3] An **undergraduate degree** is a degree that is awarded upon completion of a general course of study that typically last four years.

validation [N-UNCOUNT-U14] **Validation** is making sure that software satisfies the user's needs.

vector [N-COUNT-U15] A **vector** is a DNA molecule that is used to transfer genetic material from one cell to another.

verification [N-UNCOUNT-U14] **Verification** is making sure that software meets its design specifications.

verification [N-UNCOUNT-U6] **Verification** is the process of establishing the accuracy or truth of something.

vision [N-UNCOUNT-U6] A **vision** is an imaginative conception of something which has not happened yet.

visual aid [N-COUNT-U4] A **visual aid** is an image that people look at during a presentation.

water rights [N-COUNT-U12] A **water right** is the right of a person to use water from a source like a river or stream.

width [N-COUNT-U8] **Width** is how wide something is.

X axis [N-COUNT-U7] The **x axis** is the horizontal axis on a graph.

Y axis [N-COUNT-U7] The **y axis** is the vertical axis on a graph.

CAREER PATHS

Engineering

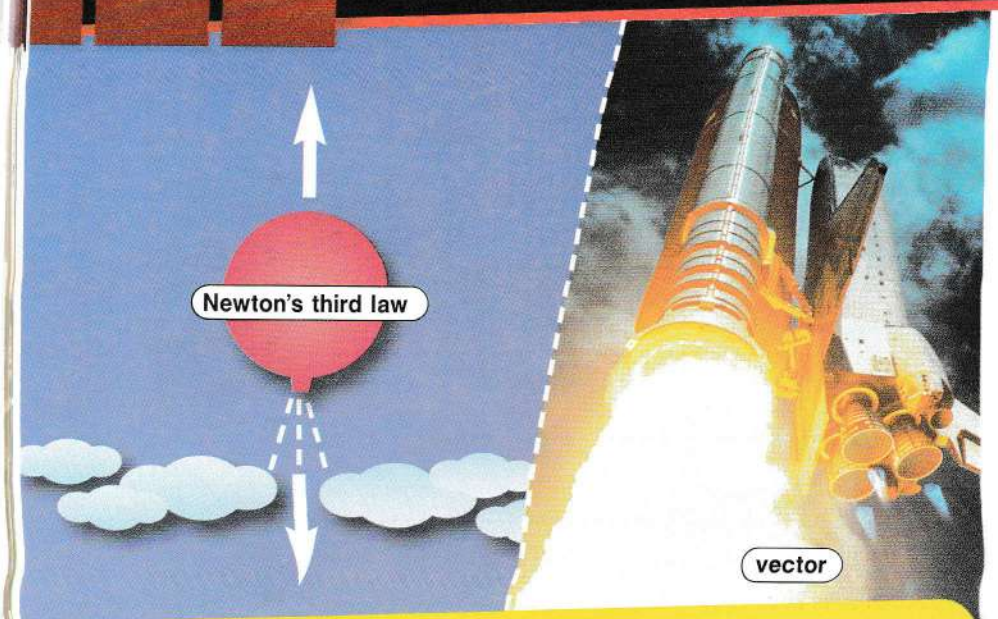
Book 3

Charles Lloyd
James A. Frazier - Jr. MS

Express Publishing

Table of Contents

1 Newton's laws



To: Engineering Team
From: Gary Cooper
Subject: Rocket Design Issues

It has come to my attention that our engineers have encountered design problems with the Astro rocket. The fuel required to reach sufficient speed weighs too much for proper liftoff and orbiting in space.

In my experience, the solution to a problem often lies right in front of us. Take a step back and focus on the basic principles guiding rocket design and construction. Thinking back to Newton's laws may help.

Newton's first law of **inertia** tells us that we need a **net force** to propel the craft forward. Without such a force, the rocket will remain at **rest** or continue in **motion** at the same **velocity**. **Newton's second law** dictates that the rocket's **acceleration** relies upon the force **vector** of its propellants and the **mass** of the rocket itself. Remember, of course, that the rocket's mass changes as it consumes its propellant. Finally, **Newton's third law** reminds us that the force of the expulsion of gas backwards creates a reaction that propels the rocket in a forward motion. Keep in mind that atmospheric air **friction** will affect both the force of the action and reaction.

Hopefully this refresher will enable you to overcome the design problems and move forward with construction.

Best,
Gary

Get ready!

1 Before you read the passage, talk about these questions.

1 What are some of Isaac Newton's discoveries?
2 When do engineers use Newton's Laws?

Reading

2 Read the email from a manager to some engineers. *Then, complete the table using* information from the passage.

Newton's Laws	Effect on Rocket
First law	_____ _____
Second law	_____ _____
Third law	_____ _____

Vocabulary

3 Match the words (1-6) with the definitions (A-F).

1 __ inertia
2 __ Newton's second law
3 __ vector
4 __ Newton's first law
5 __ acceleration
6 __ motion

A law stating that force equals mass times acceleration
B the state of an object when it is moving
C a force that keeps an object in the same position
D an increase in an object's speed
E a quantity that has both a size and a direction
F law stating that objects will remain at rest or move in a straight line unless a net force acts upon them

4 Fill in the blanks with the correct words: *rest, friction, mass, Newton's third law, velocity, net force.*

1 The speed at which a car moves is its _____.
2 The ball is still, so it is in a state of _____.
3 A heavy, dense object has a lot of _____.
4 _____ slows moving objects.
5 The forces exerted on an object equal its _____.
6 Air leaving and pushing a balloon displays _____.

5 Listen and read the email. Which of Newton's Laws tells us how quickly the rocket will gain speed?

Listening

6 Listen to a conversation between two engineers. Mark the following statements as true (T) or false (F).

1 __ The woman wants to focus on Newton's first law.
2 __ The engineers must reduce the mass of the rocket.
3 __ A lack of air friction in space means they need less fuel.

7 Listen again and complete the conversation.

Engineer 1: Hey, Tammy. Did you see Gary's email?
Engineer 2: Yes, I have it **1** _____ _____.
Engineer 1: What do you think of the advice? About focusing on the basic principles of motion?
Engineer 2: I think it'll help. Especially if we focus on Newton's **2** _____ _____.
Engineer 1: How will that help us?
Engineer 2: Well, we need a **3** _____ _____ backwards to create an equal force forward, right?
Engineer 1: Yes. But our calculations show that we need **4** _____ _____ _____ to create that force.
Engineer 2: Well, let's **5** _____ _____ _____. We have to counteract the mass of the rocket.
Engineer 1: Yes, and the air friction that occurs, too.
Engineer 2: That's right. So the force must equal the rocket's mass plus **6** _____ _____.
Engineer 1: Correct. But creating that force requires too much fuel.
Engineer 2: Wait a second. I think we made a mistake.
Engineer 1: What do you mean?
Engineer 2: Our calculations assume that air friction is present throughout the trip. But that's not correct.
Engineer 1: You're right! There will be no air friction in space.
Engineer 2: Exactly. We don't need so much fuel after all.

Speaking

8 With a partner, act out the dialogue from Task 7. Then switch roles.

USE LANGUAGE SUCH AS:

What do you think of the advice?
How will that help us?
I think we made a mistake.

Student A: You are trying to fix a problem with a rocket. Talk with Student B about:

- Newton's third law
- amount of fuel
- errors in calculations

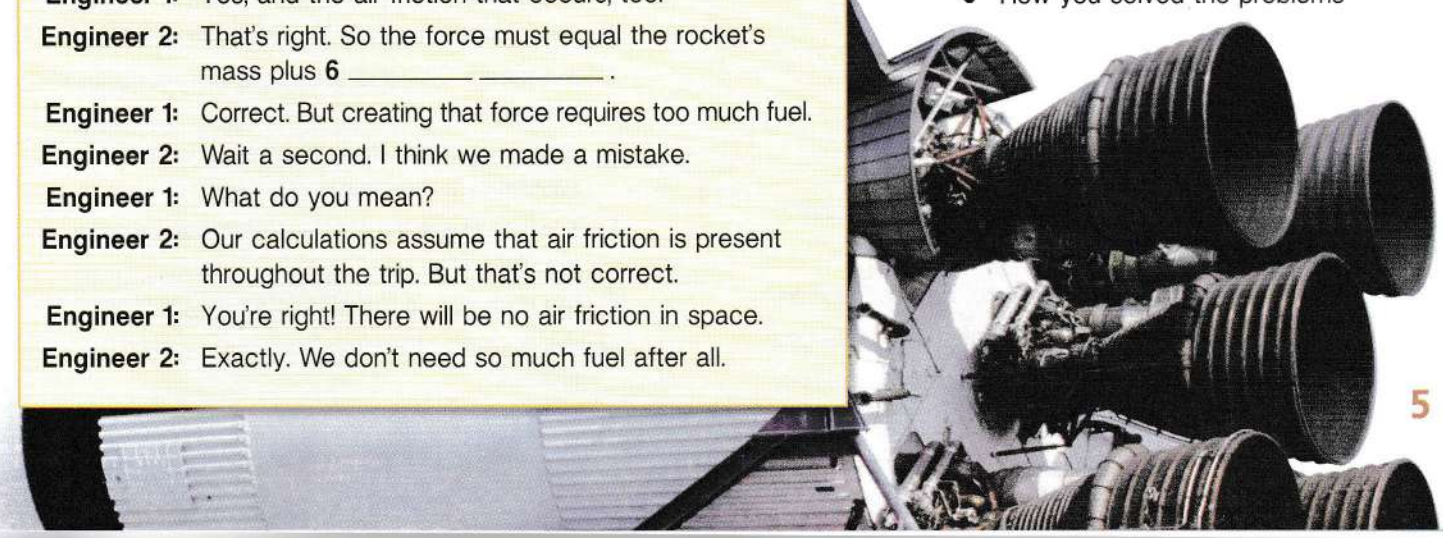
Make up a name for your co-worker.

Student B: You are trying to solve the rocket problem. Discuss the above points with Student B.

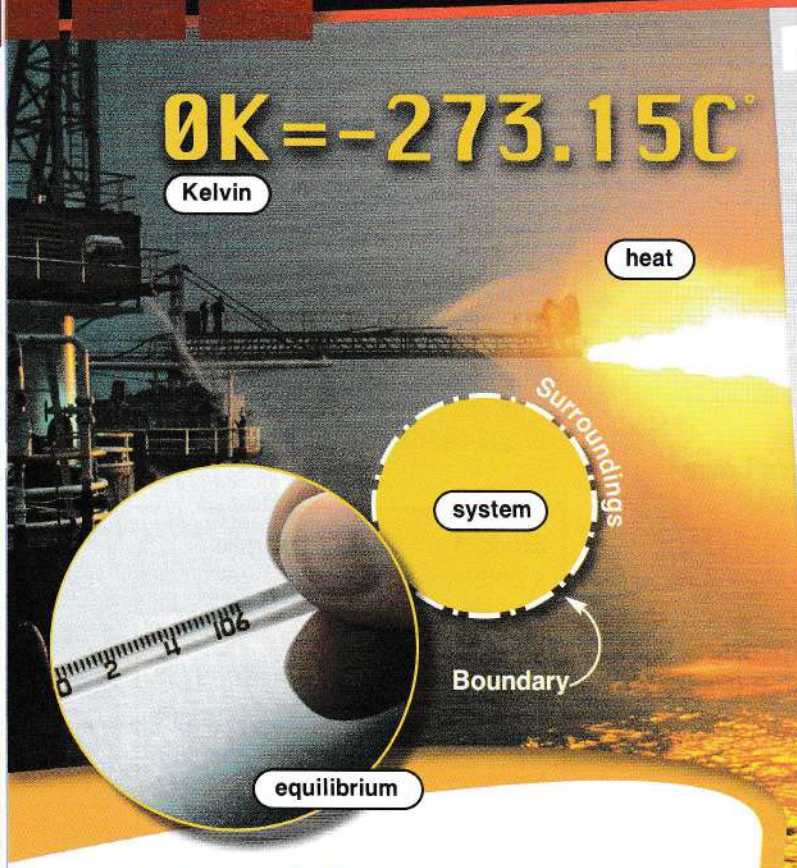
Writing

9 You are working on developing a space rocket. Use the email and the conversation from Task 8, write a brief progress report (100-120). Make sure to write about:

- What problems you encountered
- How you used Newton's laws
- What mistakes you made
- How you solved the problems



2 Laws of thermodynamics



Los Angeles Journal-Star

Scientists Nearing Absolute Zero

LOS ANGELES - Scientists believe they are near to creating a **temperature** close to zero degrees **Kelvin**, the theoretical condition known as absolute zero wherein a **system** contains no **internal energy**. This sounds impressive, but most readers probably don't understand the Laws of Thermodynamics, so let's run through some of the basics:

The **First Law of Thermodynamics** deals with the **conservation of energy**. It says that energy can be changed, but it can never be created or destroyed. The **Second Law of Thermodynamics** addresses **entropy**, which is the measure of how organized a system is. Absolute zero would involve entropy reaching its minimum value. The **Third Law of Thermodynamics** states that attaining absolute zero is impossible. A system at absolute zero could not reach **equilibrium** with the systems around it, because if it received any of their energy through the transfer of **heat**, it would no longer be at zero.

But even though absolute zero cannot be reached, the team of scientists is seeing how close they can come to it. They say this research is valuable because it helps them understand deep space, a place that consistently experiences temperatures near absolute zero. Creating these conditions in a laboratory allows these scientists to study processes and reactions that they could only imagine before.

Get ready!

1 Before you read the passage, talk about these questions.

1 Why is it important to understand very low temperatures?

2 Why must engineers understand the Laws of Thermodynamics?

Reading

2 Read the newspaper article. Then, choose the correct answers.

1 What is the article mostly about?

A a scientific experiment
B methods of decreasing entropy
C the achievement of equilibrium
D the importance of conserving energy

2 A system's organization is measured by

A entropy
B equilibrium
C internal energy
D temperature

3 What can be inferred about the experiment?

A It will never reach absolute zero.
B It has been continuing for several months.
C It has made little progress towards its goal.
D It has been performed in outer space too.

Vocabulary

3 Match the words (1-7) with the definitions (A-G).

1 __ 1st Law of Thermodynamics
2 __ 2nd Law of Thermodynamics
3 __ 3rd Law of Thermodynamics
4 __ temperature
5 __ heat
6 __ internal energy
7 __ system

A a concept that addresses entropy
B a set of separate bodies that form a whole
C a concept that addresses the conservation of energy
D energy resulting from the motion of a substance's molecules.
E a concept stating that systems can't reach absolute zero
F the measure of the kinetic energy in matter
G the transfer of energy from one system to another

4 Use the words from the word bank to fill in the blanks.

WORD BANK

absolute zero entropy Kelvin
conservation of energy equilibrium

1 Hot and cold systems that interact will reach _____.
2 _____ concerns organization in systems.
3 Convert those temperatures to _____.
4 _____ means that energy can't be destroyed.
5 At _____, all processes stop.

5 Listen and read. Why can the temperature absolute zero never be reached?

Listening

6 Listen to a conversation between a reporter and an engineer. Mark the following statements as true (T) or false (F).

1 __ The man received questions about the experiment.
2 __ The experiment shows how gases behave in space.
3 __ 2.73° Kelvin is the coldest natural temperature.

7 Listen again and complete the conversation.

Reporter: The first reader wants to know more about why reaching absolute zero is **1** _____.
Engineer: Well, reaching absolute zero can't be done because a system that is at absolute zero would have to be **2** _____ _____ _____ _____.
Reporter: Why is that?
Engineer: Systems always seek **3** _____, so heat will always transfer between systems. A system at absolute zero would receive heat from 4 _____ systems.
Reporter: Interesting! Okay, here's another. Why is it important to **5** _____ absolute zero?
Engineer: It helps us understand **6** _____ _____.
Reporter: How's that?
Engineer: The **7** _____ _____ _____ is a constant 2.73° Kelvin, which is pretty close to absolute zero.
Reporter: I see.
Engineer: So by recreating this temperature, we can understand how things such as **8** _____ _____ behave in such extreme cold.

Speaking

8 With a partner, act out the dialogue from Task 5. Then switch roles.

USE LANGUAGE SUCH AS:

Why is it important to study absolute zero?

It helps us understand deep space.

Student A: You are a reporter interviewing an engineer. Ask Student B about:

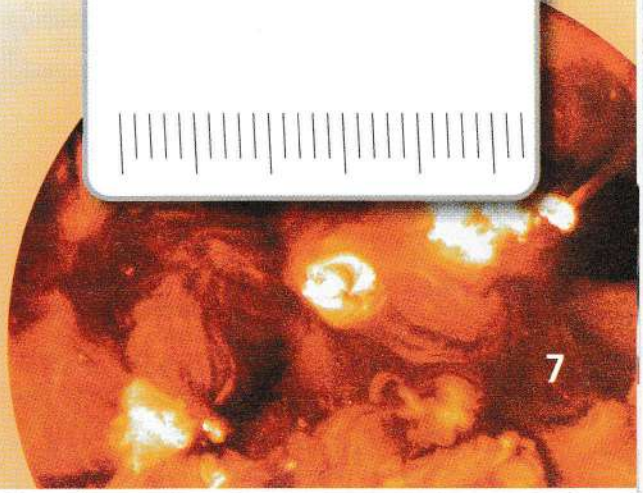
- absolute zero
- experiment's importance
- what can be learned

Student B: You are an engineer. Answer Student A's questions

Writing

9 You are a reporter trying to help readers understand the Laws of Thermodynamics. Use the article and the conversation from Task 8, to write an article about the laws and absolute zero (100-120 words). Write about:

- The Laws of Thermodynamics
- Absolute zero
- How the Laws of Thermodynamics fit together
- How it helps scientists understand deep space



3 Rate processes

Get ready!

1 Before you read the passage, talk about these questions.

1 Why might the flow of a liquid be important to an engineer?

2 When do engineers consider rate processes?

SMITH AND ASSOC. ENGINEERING, LLC

HOSE PRESSURE PROBLEM STUDY FOR NEW YORK CITY FIRE DEPARTMENT

Background

The City of New York asked *Smith and Assoc. Engineering, LLC* to look into recent complaints from the New York City Fire Department about weak hose **pressure** and low **flow rates** when attempting to extinguish fires.

Findings

Since the water being used across the city is approximately the same temperature and quite far from becoming a **superfluid**, we assumed that the water was not the problem. After all, water of the same temperature exhibits a consistently low **viscosity** according to the **Poiseuille equation**.

We suspected therefore that the problem must be with the **rate** at which the water is being forced through the hoses. Taking measurements at the **inlet** and **outlet** of a standard-issue fire hose confirmed these suspicions. The rate of **flux** at the outlet was lower than that at the inlet, meaning that the **driving force** behind the water was simply too weak.

Suggestions

The simplest solution would be to decrease the **diameter** of the hoses used by the department. This would cause an increase in **resistance**, forcing the water to speed up as it goes through the hose, and increasing the flow rate and pressure at the outlet.

$$\varphi \frac{dV}{dt} = \upsilon \pi R^2 = \frac{\pi R^4}{8\eta}\left(\frac{-\Delta P}{\Delta x}\right) = \frac{\pi R^4}{8\eta}\frac{|\Delta P|}{L}$$

Poiseuille equation

diameter

inlet

outlet

flow rate

Reading

2 Read this report from an engineering firm. Then, choose the correct answers.

1 What is the report mostly about?

A the impact of viscosity on flow rates
B the importance of high water pressure
C the reason for a flow rate problem
D the fire hoses' inlet design flaws

2 Which of the following caused the problem?

A high-viscosity fluids
B small-diameter hoses
C too much outlet pressure
D insufficient driving force

3 Using smaller-diameter fire hoses will likely

A increase the viscosity of the water.
B reduce complaints from firefighters.
C decrease the pressure placed on the outlets.
D create budget problems for the fire department.

Vocabulary

3 Read the sentence pairs. Choose where the words best fit in the blanks.

1 **inlet / outlet**

A larger _____ lets more water flow in.

The small _____ can't release the water fast enough.

2 **pressure / driving force**

The _____ behind the water is the pump.

Putting too much _____ on glass will break it.

3 **resistance / viscosity**

The tube's small diameter is creating a lot of _____.

The liquid's high _____ won't let it flow quickly.

4 **flux / rate**

Determine the liquid's _____ as it passes through a screen.

The tank is being filled at a _____ of ten liters an hour.

4 Use the words from the word bank to fill in the blanks.

WORD BANK

flow rate diameter
Poiseuille equation superfluid

1 A _____ can move out of a container by itself.
2 The _____ of the circle is 7.5 centimeters.
3 Increase the pipe size if the _____ is too low.
4 Apply the _____ to that problem.

5 Listen and read. Why is the water pressure believed to be low?

Listening

6 Listen to a conversation between a civil engineer and the fire chief. Mark the following statements as true (T) or false (F).

1 __ The man worries that the hoses are too expensive.
2 __ The woman believes that viscosity is the problem.
3 __ The man decides to change all of the inlets.

7 Listen again and complete the conversation.

Engineer: Well, your firefighters say that the flow of water from their fire hoses is too weak, correct?
Chief: That's right.
Engineer: I see. Well, I think we've found a solution.
Chief: What's that?
Engineer: The water 1 _____ is obviously the same across the entire city, so that's not the issue.
Chief: Okay. That makes sense.
Engineer: Instead, we believe the 2 _____ of your hoses is too big for the amount of pressure you're getting at the inlet.
Chief: I see. So we need 3 _____ _____?
Engineer: Correct. If the 4 _____ _____ behind the water entering the hose stays the same, a smaller hose would increase the 5 _____ at the outlet.
Chief: I'm not sure that'll work. It would probably be 6 _____ _____.
Engineer: Well then you've only got one other option, and that's to replace all of the 7 _____ you're using.

Speaking

8 With a partner, act out the dialogue from Task 5. Then switch roles.

USE LANGUAGE SUCH AS:

Well, I think we've found a solution.
So we need smaller hoses?
I'm not sure that'll work.

Student A: You are talking to a fire chief about a flow rate problem. Talk to Student B about:

- the problem
- cause of problem
- solutions

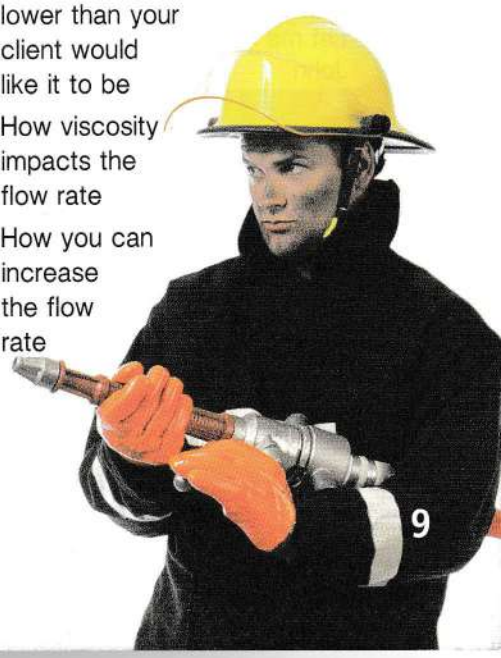
Student B: You are a fire chief. Answer Student A's questions.

Make up an name for the engineer.

Writing

9 You are an engineer trying to solve a flow rate issue. Use the report and the conversation from Task 8, to write about the causes and a potential solution (100-120 words). Write about:

- Why the flow rate is lower than your client would like it to be
- How viscosity impacts the flow rate
- How you can increase the flow rate



4 Statics and dynamics

Get ready!

1 Before you read the passage, talk about these questions.

1 What is the difference between statics and dynamics?

2 Why are statics and dynamics important to engineers?

From: John Thomas <jthomas@buildco.com>
To: Sally Adams <sadams@buildco.com>
Subject: Bridge Testing

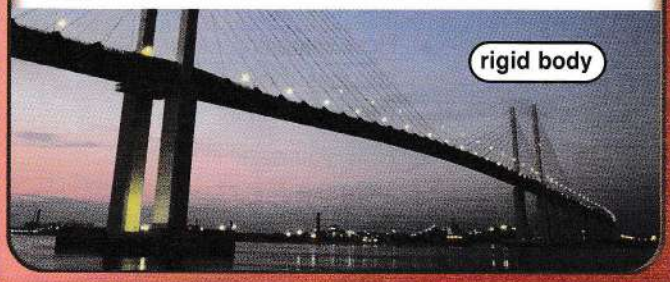
Sally,
Attached to this e-mail is the **free body diagram** showing all the different forces that act on the bridge. Of course, a diagram is not enough to assess such a **rigid body**, so I'm hoping to begin testing the bridge as soon as possible.

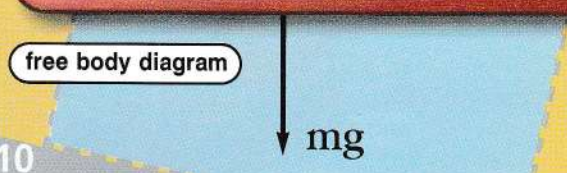
For the **statics** test I'd like to suggest using a structural testing system. It's a **portable** device that requires minimal surface setup in order to test the structure. It requires little assembly, unlike other devices, and even comes with testing software. I highly recommend this to make the testing process more efficient.

As usual, we'll have to stop all traffic over the bridge so the structure can be at equilibrium. I recommend that we send a heavy truck across to test the effect its **moment** has on the **load**. That way, we can define its **safety factor**. But if we use the portable testing system, we'll reduce the time it takes by two-thirds.

Since the bridge is in an earthquake zone, we'll still need to do regular **dynamics** tests. An earthquake of the right **magnitude** could completely destroy the bridge. Thus, we need to test how much force from the **vibrations** would disrupt the bridge's **stability**.

Let me know what you think.
John





Reading

2 Read this e-mail from an engineer to his supervisor. Then, choose the correct answers.

1 What is the e-mail about?
- **A** testing a bridge for safety
- **B** how to conduct a dynamics test
- **C** building a bridge in an earthquake zone
- **D** how to set up a structural testing system

2 What is NOT a benefit of the testing system?
- **A** It is portable.
- **B** It can test dynamics.
- **C** It requires minimal set up.
- **D** It significantly reduces testing time.

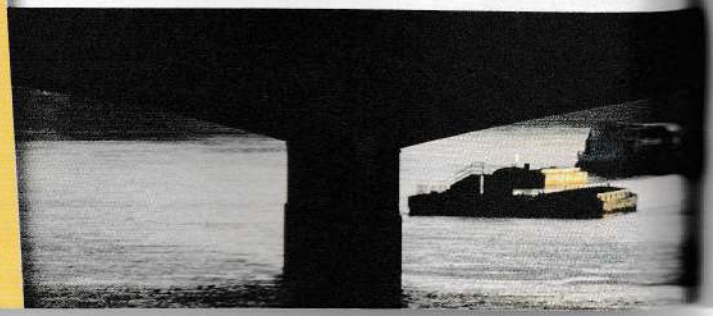
3 What can you infer about the bridge?
- **A** It was built recently.
- **B** It is safe during earthquakes.
- **C** It is currently in use.
- **D** It has survived an earthquake.

Vocabulary

3 Match the words (1-7) with the definitions (A-G).

1 __ portable
2 __ rigid body
3 __ safety factor
4 __ dynamics
5 __ moment
6 __ statics
7 __ vibration

- **A** made to be carried around
- **B** the study of the causes of motion
- **C** a structure unchanged by applied force
- **D** a series of rapid movements back and forth
- **E** the force causing an object to turn on an axis
- **F** the study of objects at rest
- **G** the ability to withstand a load.



4 **Use the words from the word bank to fill in the blanks.**

WORD BANK

stability magnitude
load free body diagram

1 Place a heavy _____ on the structure.
2 A _____ shows forces at work on a structure.
3 Applied force may disrupt a structure's _____.
4 A high _____ earthquake damaged the city.

5 **Listen and read. How can the static testing of the bridge be undertaken efficiently?**

Listening

6 **Listen to a conversation between a supervisor and an engineer. Mark the following statements as true (T) or false (F).**

1 __ The woman thinks the new system will slow testing.
2 __ The woman does not approve the new system.
3 __ The woman wants to continue regular testing.

7 **Listen again and complete the conversation.**

Supervisor: Hey John. I got your e-mail about the **1** _____ _____ _____.
Engineer: Yeah? What do you think about it?
Supervisor: I like the sound of it, and I definitely think it will make things faster.
Engineer: That's great. Are you approving it, then?
Supervisor: I am, but I **2** _____ _____ _____ _____.
Engineer: Which is?
Supervisor: I think we should do **3** _____ _____ _____, too.
Engineer: Doesn't that **4** _____ _____ _____ of getting a new system?
Supervisor: I'm just **5** _____ _____ _____ _____ to a different one yet.
Engineer: So you want to compare the effectiveness of the device **6** _____ _____ _____?
Supervisor: Exactly. If it's just as **7** _____ _____ _____ _____, then we'll switch to it in the future.

Speaking

8 **With a partner, act out the dialogue from Task 5. Then switch roles.**

USE LANGUAGE SUCH AS:

I got your e-mail about the ...
I have one concern.
Doesn't that defeat the purpose of getting a new system?

Student A: You want to use a new structural testing system. Talk to Student B about:

- opinion
- approval
- comparison

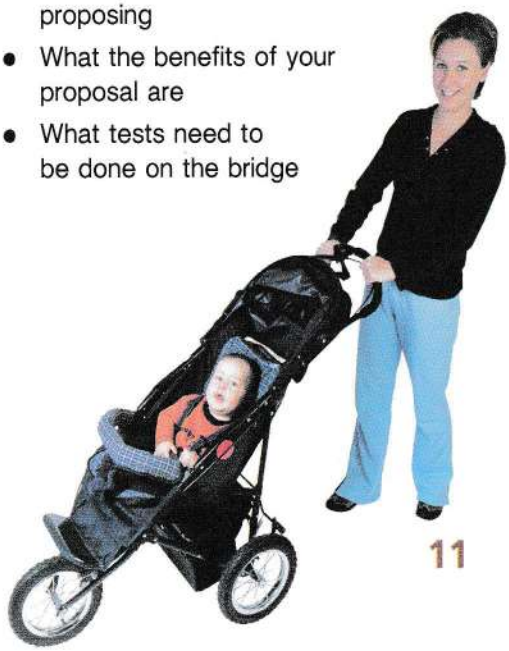
Student B: You are a supervisor. Answer Student A's questions.

Make up a name for your engineer.

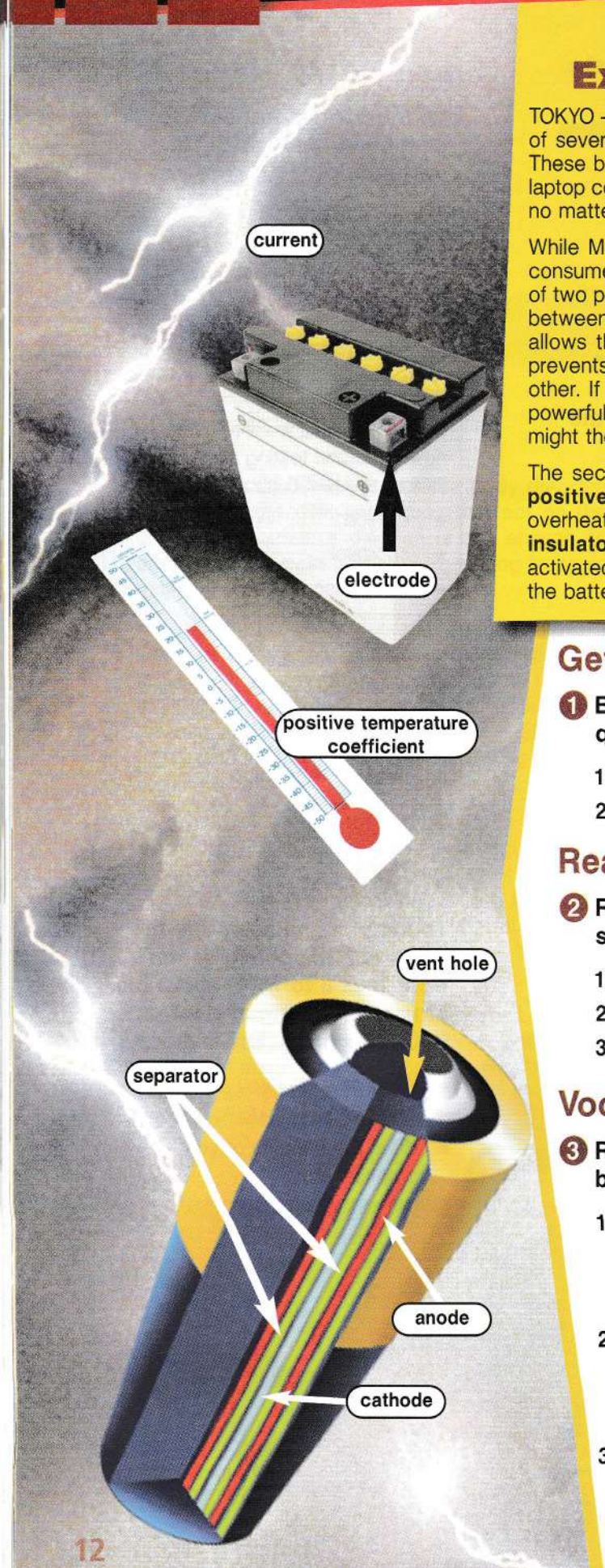
Writing

9 **You are an engineer. Use the email and the conversation from Task 8 to write about the structural testing system (100-120 words). Write about:**

- What new idea you are proposing
- What the benefits of your proposal are
- What tests need to be done on the bridge



5 Electricity



The Daily Journal

Exploding Batteries Recalled

TOKYO - **Battery** giant Morioka is recalling its **lithium** batteries as a result of several documented explosions involving its PowerPlus product line. These batteries can be found in numerous consumer devices, including laptop computers. It is thought that the entire line is potentially dangerous, no matter which type of device they are installed in.

While Morioka has not publicly identified the cause of the explosions, consumer safety groups state that the problem is likely caused by one of two possibilities. The first is related to the **separator sheet** that exists between the battery's **electrodes**–its **anode** and **cathode.** This sheet allows the **current** to pass through it when the battery **charges**, but prevents the anode and cathode from coming into contact with each other. If the separator sheet is punctured, these electrodes, which are powerful **conductors,** can touch and become extremely hot. The battery might then explode after reaching a critical temperature.

The second possibility is related to a potentially faulty **vent hole** and **positive temperature coefficient (PVC)** switch. When a battery overheats, pressure builds up inside of it. The vent hole located in the **insulator** on top of the battery should release that pressure when activated by the PVC. But should the switch or the vent hole malfunction, the battery can explode.

Get ready!

1 Before you read the passage, talk about these questions.

1 How can electricity be dangerous?
2 When do engineers work with electricity?

Reading

2 Read the newspaper article. Then, mark the following statements as true (T) or (F) false.

1 __ Batteries can explode if their separator sheets touch.
2 __ Dividing a cathode and an anode may cause explosions.
3 __ Vent holes release pressure after temperatures increase.

Vocabulary

3 Read the sentence pairs. Choose where the words best fit in the blanks.

1 vent hole / separator sheet

A bigger _____ will release more pressure.
A punctured _____ in a battery is dangerous.

2 conductor / insulator

A(n) _____ prevents the flow of electric currents.
A(n) _____ aids the flow of electric currents.

3 *anode / cathode*

Electricity leaves a battery through the _____.
Charge your battery through its _____.

4 Match the words (1-6) with the definitions (A-F).

1 __ electrode
2 __ lithium
3 __ charge
4 __ current
5 __ battery
6 __ positive temperature coefficient

A a measure of electrical resistance when temperature rises
B to store energy
C a conductor that makes contact with non-metal circuit parts
D an item that turns chemical energy into electrical energy
E a soft, silver metal
F a flow of electrons

5 Listen and read. What does a separator sheet do?

Listening

6 Listen to a conversation between two engineers. Choose the correct answers.

1 What is the conversation mostly about?
A ways to improve media reports
B reasons why the batteries are exploding
C the dangers of punctured separator sheets
D products that the batteries are used in

2 What are the engineers most likely to do next?
A Call the consumer safety groups for help.
B Inform the press that the problem is solved.
C Give a press release explaining the problem.
D Examine the remaining uninspected batteries.

7 Listen again and complete the conversation.

Engineer 2: So what do you think the problem is?
Engineer 1: Actually, I think those **1** _____ _____ _____ people probably have it right.
Engineer 2: I do too. I don't think it's the **2** _____ _____, though.
Engineer 1: Why's that?
Engineer 2: Well, the **3** _____ I've inspected didn't have punctured sheets. That means the **4** _____ couldn't touch.
Engineer 1: The one I saw didn't have a punctured separator sheet, either.
Engineer 2: So you think it's the **5** _____, then?
Engineer 1: Probably. The switch must have failed to open the **6** _____ _____ and release the pressure.
Engineer 2: That would definitely cause it to explode.
Engineer 1: Right. Do you have any **7** _____ _____ we could look at to back this idea up?

Speaking

8 With a partner, act out the dialogue from Task 5. Then switch roles.

USE LANGUAGE SUCH AS:

So what do you think the problem is?

Actually, I think ...

Well, the batteries I've inspected didn't ...

Student A: You are discussing the battery problem with another engineer. Talk to Student B about:

- batteries you both inspected
- cause of problem

Student B: You are an engineer. Answer Student A's questions.

Writing

9 You are investigating batteries that are exploding. Use the conversation from Task 8 to write an email to your colleague about your findings and your conclusions (100-120 words). Write about:

- What you've found in the batteries you've inspected
- What you think isn't causing the problem
- What you think is causing the problem
- What you're going to do next

6 SI System of Units

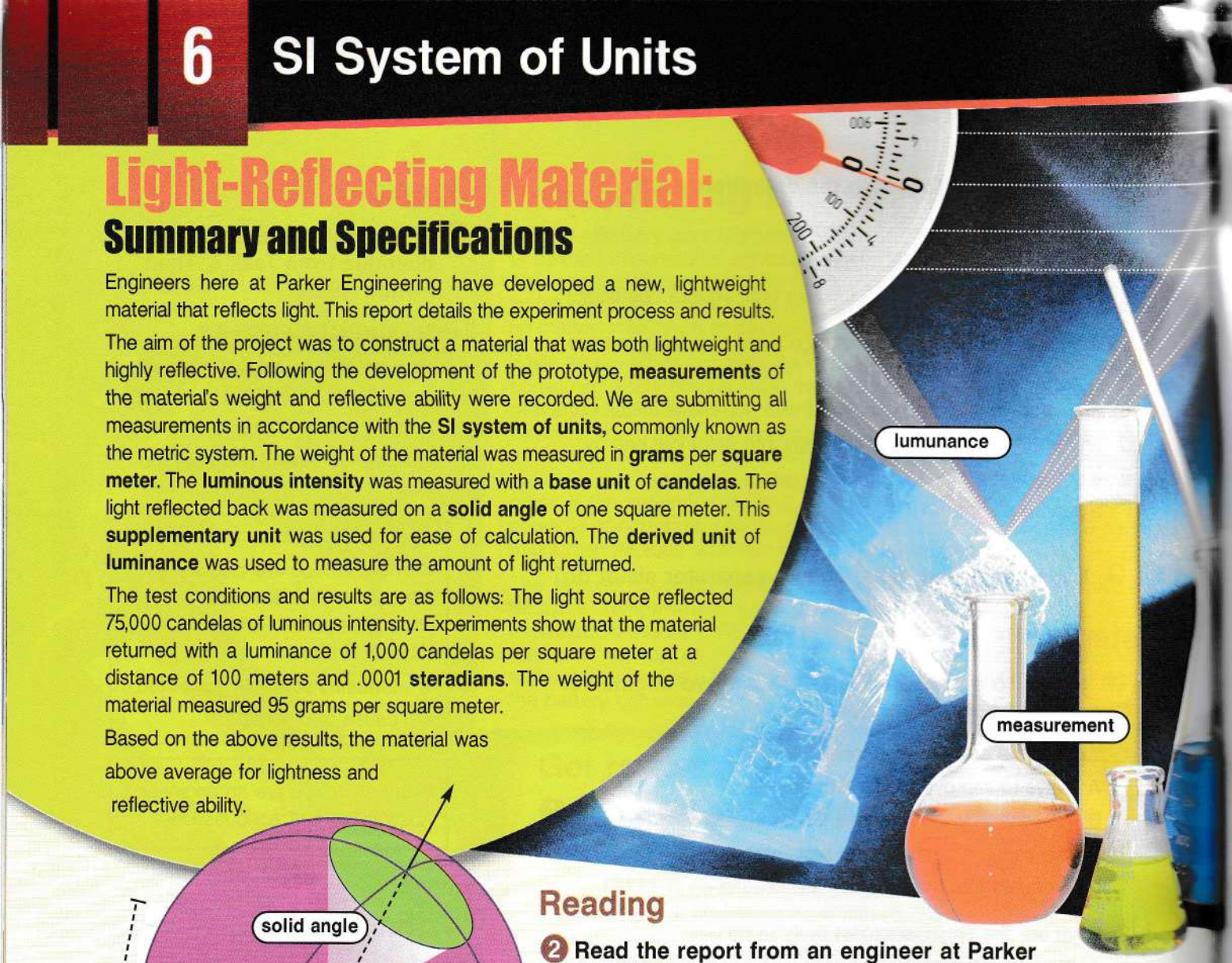
Light-Reflecting Material:
Summary and Specifications

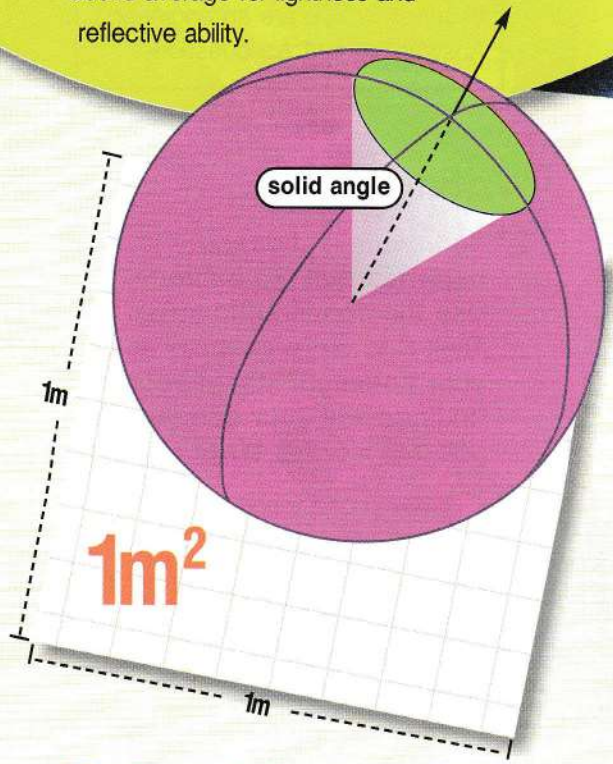
Engineers here at Parker Engineering have developed a new, lightweight material that reflects light. This report details the experiment process and results.

The aim of the project was to construct a material that was both lightweight and highly reflective. Following the development of the prototype, **measurements** of the material's weight and reflective ability were recorded. We are submitting all measurements in accordance with the **SI system of units,** commonly known as the metric system. The weight of the material was measured in **grams** per **square meter**. The **luminous intensity** was measured with a **base unit** of **candelas**. The light reflected back was measured on a **solid angle** of one square meter. This **supplementary unit** was used for ease of calculation. The **derived unit** of **luminance** was used to measure the amount of light returned.

The test conditions and results are as follows: The light source reflected 75,000 candelas of luminous intensity. Experiments show that the material returned with a luminance of 1,000 candelas per square meter at a distance of 100 meters and .0001 **steradians**. The weight of the material measured 95 grams per square meter.

Based on the above results, the material was above average for lightness and reflective ability.





Get ready!

1 Before you read the passage, talk about these questions.

1 What types of measurement are you familiar with?

2 What can you measure with the SI system of units?

Reading

2 Read the report from an engineer at Parker engineering. Then, mark the following statements as true (T) or false (F).

1 __ Engineers recorded the material's reflective ability.

2 __ Luminous intensity was measured with candelas.

3 __ The prototype did not meet the weight requirements.

Vocabulary

3 Match the words (1-7) with the definitions (A-G).

1 __ luminous intensity
2 __ supplementary unit
3 __ solid angle
4 __ base unit
5 __ steradian
6 __ SI system of units
7 __ derived unit

A a measurement system with seven types of units
B a two-dimensional angle in a sphere
C the power of light the human eye can perceive
D a unit of measurement formed by combining base units
E a measurement unit beyond the seven basic types
F a unit of measurement for angles
G one of seven basic units of measurement

4 Write a word that is similar in meaning to the underlined part.

1 One <u>unit of measurement for mass</u> is very light. g _ _ m
2 This lamp emits 120 <u>units of luminous intensity</u>. c _ n _ _ l _ s
3 Record the exact <u>dimensions</u>. _ _ a _ _ r _ m _ _ _ s
4 How many <u>units of measurement for area</u> is the yard? _ q _ _ r _ m _ _ e _ s
5 Measure the <u>reflection's brightness from a distance</u>. _ u _ _ n _ _ c _

5 Listen and read. How much does the new material weigh?

Listening

6 Listen to a conversation between an engineer and a clothing manufacturer. Choose the right answers.

1 What is the main idea of the dialogue?
- **A** describing the production process
- **B** selling the material to a manufacturer
- **C** reducing how much the material weighs
- **D** negotiating the cost of the material

2 According to the dialogue, what is NOT an advantage of the product?
- **A** It does not weigh very much.
- **B** It is extremely reflective.
- **C** Its price has been reduced.
- **D** It can be placed on safety clothing.

7 Listen again and complete the conversation.

E: Ms. Platt, thanks for **1** _____ _____ _____ to meet with me.
M: My pleasure. So, what's this great new product you mentioned on the phone?
E: It's a super reflective material. Its **2** _____ is very high.
M: And what exactly is it designed for?
E: It would work great for **3** _____ _____. Small strips placed on uniforms can reflect large amounts of light.
M: And how much does it cost?
E: Well, the production process is rather involved. So it costs about 70 dollars **4** _____ _____ _____.
M: That's **5** _____ _____ _____. Other reflective materials are available for less.
E: But ours reflects twice as much light as others. So you use less of it.
M: Good point. It **6** _____ _____.

Speaking

8 With a partner, act out the dialogue from Task 7. Then switch roles.

USE LANGUAGE SUCH AS:

What's this great new product you mentioned on the phone?
It's a super reflective material.
How much does it cost?

Student A: You are a clothing manufacturer. Ask Student B about a materials:
- uses
- cost

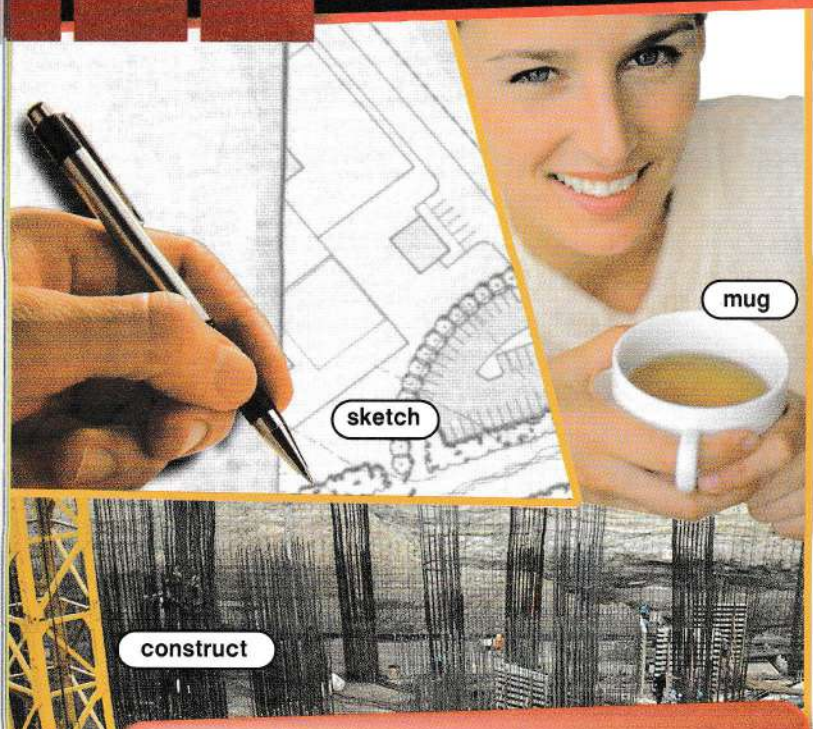
Student B: You've created a lightweight, reflective material. Answer Student A's questions.
Make up a name for the manufacturer.

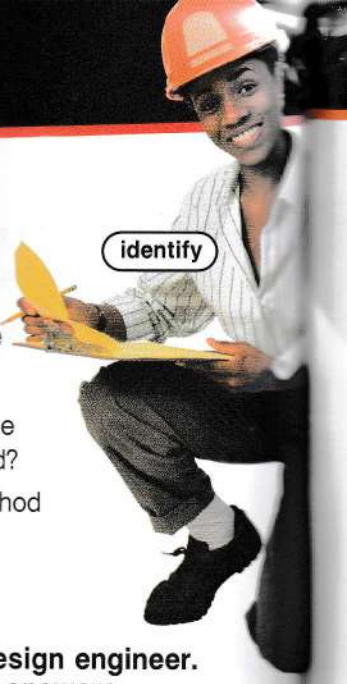
Writing

9 You are an engineer who has developed a new reflective material. Use the report and conversation from Task 8 to write a brief journal article about the material (100-120 words). Write about:

- The uses of the product
- The characteristics of the product
- Why this product is better than others

7 Engineering design method





Get ready!

1 Before you read the passage, talk about these questions.

1 What are some steps in the engineering design method?
2 Why is using a design method important?

Reading

2 Read the e-mail from a design engineer. Then, choose the correct answers.

1 What is the e-mail about?
- A problems encountered when creating a mug
- B the final results of the mug design
- C how to evaluate the initial mug design
- D the process for designing a travel mug

2 The purpose of the test model is to
- A provide Mr. Halford with the model.
- B check the effectiveness of the mug.
- C create a sample to show to consumers.
- D see if the design meets all specifications.

3 What can you infer about the travel mug?
- A Its test model probably will not work.
- B Its test model hasn't been produced.
- C It works best without a handle.
- D It has failed a recent test.

From: Helen Miller <hmiller@designco.com>
To: Ross Halford <rhalford@designco.com>
Subject: Re: Travel Mug Project

Here is an update on the travel mug project.

Having **identified** the need for a travel mug that retains heat, we've **assembled** a team to create one. As we **narrowed** our research, we determined several **constraints** for the final product. It must be:

- simple
- effective
- highly affordable
- travel-friendly

A **feasibility study** showed that this won't be too difficult.

Currently, we are in the **preliminary design** stage. We have an artist working on **sketches** for the mug. We're also figuring out just what method allows for the most effective heat retention. For example, we're deciding between a metal cup with a rubber exterior or a cup made of thick plastic. Once we're settled on a design, we'll **construct** a test model. Of course we'll show you this when it's done, and perhaps even reveal it to consumers to check market reaction. Primarily, however, we'll be doing this to **evaluate** its effectiveness.

Once we've evaluated the test model, we'll move on to the **detailed design** of the mug. We're taking into consideration such points as a need for finger grooves for easy gripping or a handle, which takes up more space. After that, we'll construct a final version and **verify** that it meets all the previously stated **criteria**.

I'll keep you posted as the project continues.
Helen

Vocabulary

3 Match the words (1-8) with the definitions (A-H).

1 __ detailed design
2 __ identify
3 __ construct
4 __ assemble
5 __ verify
6 __ evaluate
7 __ constraint
8 __ preliminary design

- A the initial blueprint of a product
- B to prove that something is correct
- C to put together
- D to test something
- E to recognize something
- F a version of a product close to what the final version will be like
- G to build something
- H a limit set on a product's design

4 Fill in the blanks with the correct words: *feasibility study, narrow, criteria, sketch.*

1 This _____ shows what the device looks like.
2 Projects must meet the stated _____.
3 Conduct a _____ as part of the research.
4 Constraints help engineers _____ their goals.

5 Listen and read. Why might they show the prototype to customers?

Listening

6 Listen to a conversation between a supervisor and an engineer. Mark the following statements as true (T) or false (F).

1 __ The final design includes a handle.
2 __ The travel mug gets too hot.
3 __ A mug without a handle saves space.

7 Listen again and complete the conversation.

Supervisor: Helen, thanks for the e-mail update earlier. How's the project going now?
Engineer: It's going well! We're just about done with the **1** _____ _____.
Supervisor: What did you decide on: handle or grips?
Engineer: We liked the look of the handle, but decided that it **2** _____ _____ _____ _____ with grips.
Supervisor: What's the benefit of less space?
Engineer: Well, companies can ship more and stores can stock more of them **3** _____ _____ _____.
Supervisor: That makes sense. And the **4** _____ _____ is all figured out?
Engineer: Yes, the interior is metal and the outside rubber grip **5** _____ it.
Supervisor: Doesn't it get too hot because of the metal?
Engineer: The cup gets warm, but not unbearably hot.
Supervisor: Why didn't the **6** _____ _____ work?
Engineer: The plastic got very hot, so it would have needed a handle.

Speaking

8 With a partner, act out the dialogue from Task 7. Then switch roles.

USE LANGUAGE SUCH AS:
How's the project going now?
What did you decide on?
Why didn't the plastic version work?

Student A: You want to know about a project's progress. Talk to Student B about:
- handle or grips
- heat retention
- a problem

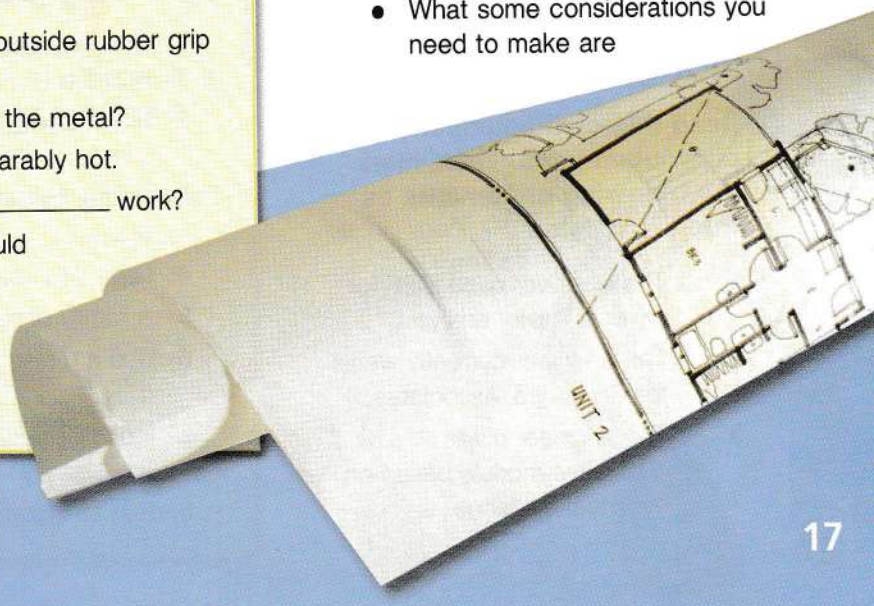
Make up a name for the engineer.

Student B: You are the engineer developing the mug. Answer Student A's questions.

Writing

9 You are an engineer working on a product design. Use the email and the conversation from Task 8 to write a description of the process (100-120 words). Write about:

- What the process of designing the product is
- What some considerations you need to make are



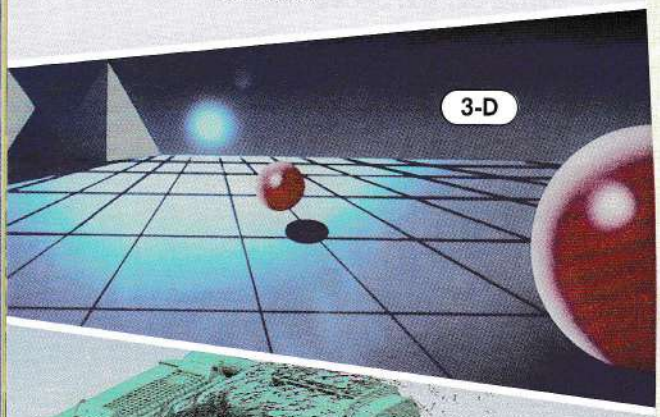
8 Models

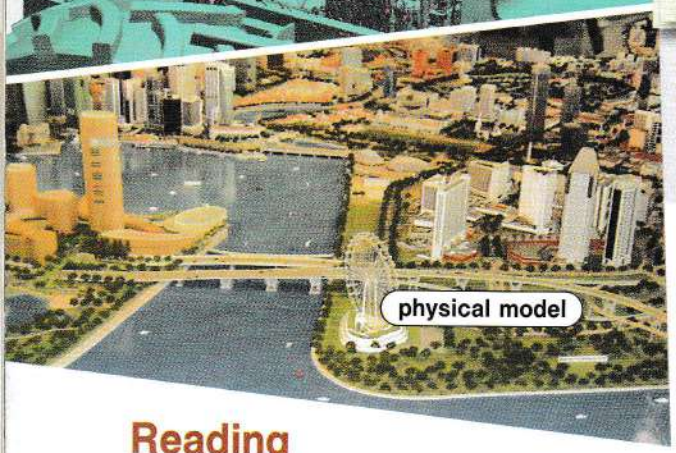
Get ready!

1 Before you read the passage, talk about these questions.

1 Why are computer models helpful?

2 When do engineers use models?





Reading

2 Read this civil engineer's curriculum vitae. Then, mark the following statements as true (T) or false (F).

1 ___ The engineer used IDEF for driver behavior analysis.

2 ___ The engineer currently works for Gregory & Associates.

3 ___ The engineer made qualitative models based on empirical evidence.

Resume

Personal Information

Name: Hillary Berkheim
Address: 56 Lincoln Street
Dover, Delaware 19902
Tel: (302) 555-7866

Objective

To secure a position as a civil engineer with Anderson Engineering Associates, Ltd

Employment History

2008-Present: Civil Engineer, Gregory & Associates
Hold primary responsibility for studying and predicting traffic patterns using **mathematical models**. Tasked with creating **digital computer models** including **3-D** models and **simulations** based on this information. Gregory & Associates frequently consulted with the City of Dover on traffic flow issues. My models and simulations were used in these consultations.

2005-2008: Civil Engineer, District of Columbia
Used **empirical** evidence to create **qualitative models** used to analyze driver behavior in heavily congested areas. These were used by the district to reduce incidences of illegal behavior. Also used **physical models** to demonstrate how to improve traffic flow near the downtown area. Utilized **analog computer models** in our office during this time, usually to run long and complicated traffic simulations.

Skills

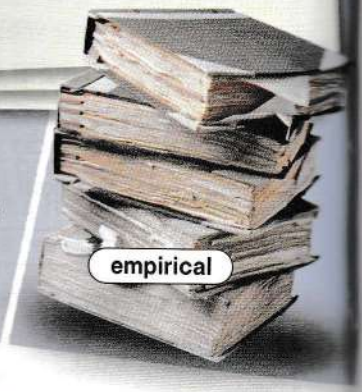
Proficient in the use of **IDEF** and **VRML modeling languages** for traffic pattern simulation and traffic flow improvement. Experienced in the use of **UML** modeling language for driver behavior analysis.

References

Heather McConnell
Chief Civil Engineer,
Gregory & Associates
Tel: (302) 555-8922

$$m\frac{d^2}{dt^2}x(t)=-\text{grad}(V)(x(t))$$

mathematical model



Vocabulary

3 Write a word that is similar in meaning to the underlined part.

1 Use this <u>equation that describes a system</u>.
m _ _ h _ _ _ _ _ c _ _ _ _ d _ l

2 Make a <u>small, realistic recreation</u> of the car.
_ h _ _ _ _ a _ m _ _ e _

3 Gather evidence that is <u>gained by observation</u>.
e _ _ _ r _ _ _ l

4 Have you used <u>a general-purpose modeling language</u>? _ M _

5 <u>A family of modeling languages</u> helps model data. _ D _ F

6 Use a <u>model that shows how things interact</u>.
q _ _ l _ t _ _ _ _ _ _ _ d e _

7 <u>Models created on analog computers</u> aren't used often.
_ n _ _ _ g c _ _ _ _ t _ _ _ o _ _ l _

8 Run an <u>imitation of events</u>. _ _ m _ _ _ _ i _ n

4 Complete the sentences using the correct words from the word bank.

WORD BANK

3-D digital computer models
VRML modeling languages

1 Knowing many _____ is useful.
2 Use _____ to create a traffic flow model.
3 _____ models show objects better than flat ones.
4 _____ are more common than physical models.

5 Listen and read. What were Hillary's qualitative models used for?

Listening

6 Listen to a conversation between a civil engineer and her potential employer. Choose the correct answers.

1 What is the conversation mainly about?
- **A** attempts to accurately model traffic flow
- **B** an engineer's experience with modeling
- **C** the minimum qualifications for the job
- **D** the importance of VRML experience

2 What is true of the civil engineer?
- **A** She is unhappy with her current job.
- **B** She dislikes working on traffic flow.
- **C** She has success with mathematical modeling.
- **D** She collected incorrect empirical evidence.

7 Listen again and complete the conversation.

Supervisor: Indeed. Tell me about your time with the 1 _____ _____ _____.
Engineer: All right. That was my first job out of college, so it gave me a great chance to get some experience.
Supervisor: Which types of modeling did you do?
Engineer: Well, I created 2 _____ models of driver behavior.
Supervisor: Interesting. What did you 3 _____ from that experience?
Engineer: We had great 4 _____ _____, but it didn't quite come together like I'd hoped. People's 5 _____ can be difficult to model.
Supervisor: I see. Tell me about your current position.
Engineer: All right. Right now I'm doing a lot of 6 _____ modeling using 7 _____.

Speaking

8 With a partner, act out the dialogue from Task 7. Then switch roles.

USE LANGUAGE SUCH AS:

Tell me about some of your modeling experience.
Which types of modeling did you do?
Tell me about your current position

Student A: You are interviewing a civil engineer. Talk to Student B about:
- modeling
- programs used
- current work

Student B: You are a civil engineer. Answer Student A's questions.

Writing

9 You are telling a potential employer about your computer modeling experience. Use the C.V. and the conversation from Task 8 to write about what you've done in your career so far (100-120 words). Write about:

- Which types of computer models you have used
- What kind of information you have modeled
- What you are working on at your current job

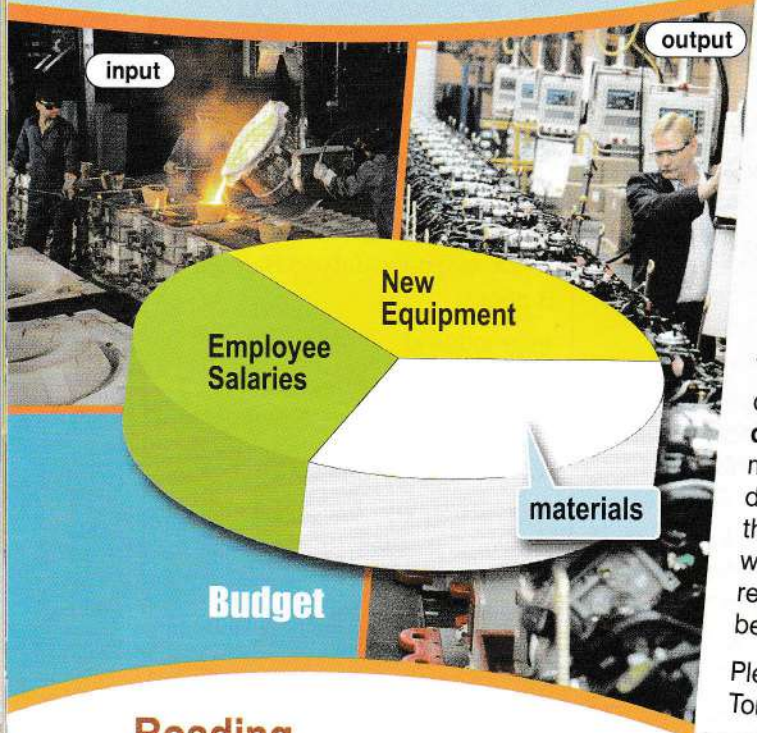
9 Accounting

Get ready!

1 Before you read the passage, talk about these questions.

1 How do engineers utilize accounting?

2 Why is accounting needed in engineering?



Initial Amount = Final Amount

Ms. Howe,

I have completed my examination of your plant. I think it's possible for you to achieve your goal of a **steady state** of production. I've used the **universal accounting equation** to account for everything in your **system**.

To begin, I looked at your **extensive quantities**. You started with an initial **input** of 50,000 units. During the study, your factory supplied a **generation** of 2,000 more units. Sales accounted for an **output** of 45,000 units. We're left with a **conserved quantity** of 7,000 units. So you're already close to a steady state of production. However, we must also account for **consumption** – you lost 1,025 units to faulty wiring and damage while shipping.

To decrease the rate of consumption and reduce conserved quantities, I recommend that you consider the **path quantities** of your system. For example, the distance units must travel in shipping may play a role. Units could get damaged in transit. There are also **intensive qualities** to think about like humidity in the air potentially damaging the wiring. Location is, of course, a **state quantity**. If you can't reduce the shipping distance, there's not much we can do besides move the entire plant.

Please contact me if you have any further questions.
Tom Sherman

$1 + Interest = $2

Reading

2 Read this report from an industrial engineer to a client. Then, choose the correct answers.

1 What is the industrial engineer writing about?

- **A** how to increase input
- **B** how to reduce consumption
- **C** a summary of a plant examination
- **D** a new universal accounting equation

2 The business owner can reduce the number of damaged units by

- **A** increasing the input.
- **B** reducing the output.
- **C** reducing shipping time.
- **D** increasing state quantities.

3 What can you infer about the plant?

- **A** It ships locally.
- **B** It produces electronics.
- **C** It will not change location.
- **D** It is already at a steady state.

Vocabulary

3 Match the words (1-8) with the definitions (A-H).

1 __ intensive quantity
2 __ consumption
3 __ output
4 __ path quantity
5 __ steady state
6 __ input
7 __ conserved quality
8 __ system

- **A** extensive quantity destroyed during a period
- **B** something that is independent of the rest of a system
- **C** system that does not increase or decrease
- **D** amount in a system that remains unchanged
- **E** section of the world an engineer monitors
- **F** extensive quantity added into a system
- **G** dependent on the course of a process
- **H** extensive quantity leaving the system

4 Use the words from the word bank to fill in the blanks.

WORD BANK

extensive quanity universal accounting equation
generation state quantity

1 Plug those figures into the _____.
2 Include the _____ of new materials.
3 The number of units sold by a company is a(n) _____.
4 Location is a(n) _____.

5 Listen and read. What does the engineer suggest be reduced in order to decrease consumption?

Listening

6 Listen to a conversation between an engineer and a producer. Mark the following statements as true (T) or false (F).

1 __ The producer can reduce shipping distance.
2 __ Outdated equipment damages many of the units.
3 __ Replacing equipment will save money overall.

7 Listen again and complete the conversation.

Producer: Hello, Mr. Sherman. I'd like to get some clarifications on that report about a **1** _____ _____.
Engineer: Of course, Ms. Howe. How can I help?
Producer: First of all, you suggested **2** _____ _____ _____. Is that really the best option?
Engineer: Yes, assuming that it's otherwise impossible to **3** _____ _____ _____ _____ like shipping distance.
Producer: I see. To be honest, I can't move the plant or reduce **4** _____ _____.
Engineer: Well, there could be another way to **5** _____ _____ _____ _____.
Producer: Really? I'd love to hear it.
Engineer: I noticed this just before you called. It's the equipment.
Producer: The equipment? What do you mean?
Engineer: It turns out that about 500 of the units were damaged by **6** _____ _____.

Speaking

8 With a partner, act out the dialogue from Task 7. Then switch roles.

USE LANGUAGE SUCH AS:

I'd like to get some clarifications on that report.
Is that really the best option?
There could be another way to ...

Student A: You want clarification on a report. Talk to Student B about:

- best options
- reducing consumption
- the equipment

Make up a name for the engineer.

Student B: You are an industrial engineer. Answer Student A's questions.

Make up a name for the producer.

Writing

9 You are an industrial engineer. Use the report and the conversation from Task 8 to write suggestions to your client (100-120 words). Write about:

- What the client's goals are
- How you can use the universal accounting equation to help them
- What the are factors keeping the plant from achieving a steady state of production are
- What solutions you can offer

10 Statistics

Get ready!

1 Before you read the passage, talk about these questions.

1 How can statistics help people?

2 When do engineers use statistics?

CRANE ENGINEERING

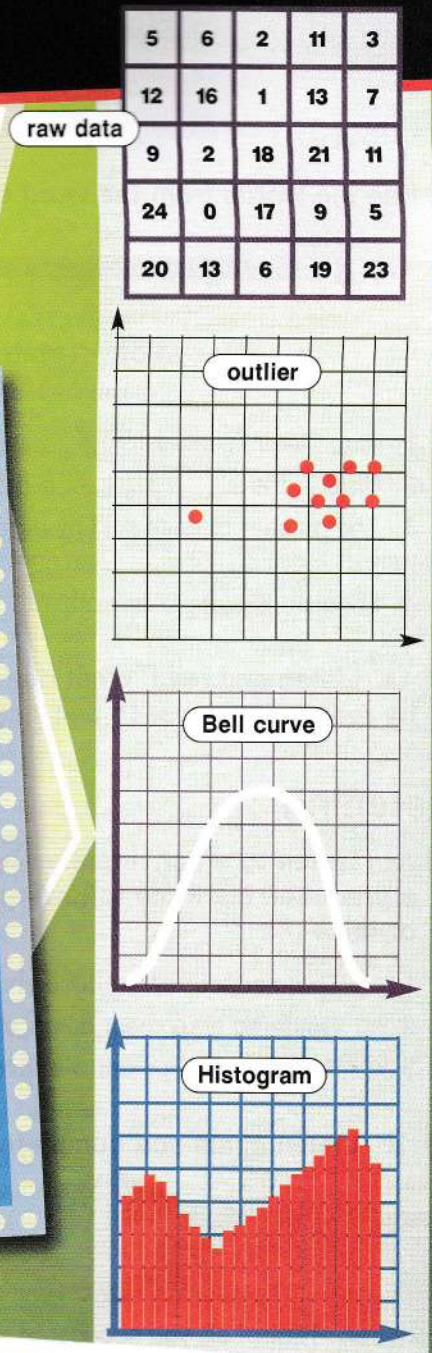
Washington Street Project Proposal

The following proposal is in response to the City of Dunlop's call for engineers to examine traffic patterns. It outlines Crane Engineering's plans for analyzing traffic patterns on Washington Street. Crane Engineering specializes in the construction and design of roads and bridges. In addition, we employ exceptional methods of **statistical quality control** for assessing existing roads in order to determine possible upgrades.

Specifically, we will take a **sample** at the intersection of Washington Street and First Street for one week. This will help determine the **population**. Each day, we will record the hourly **frequency** of vehicles that pass through the intersection. Next, we will **sort** the **raw data** into groups. We expect that some **variation** in frequency will occur naturally throughout the week. However, we will discard any glaring **outliers**. We will then plot the data on a **histogram** and analyze it to determine periods of high traffic.

We expect the data to form a **bell curve**. This graph, will most likely reveal a **range** of heavy traffic from 4:00 p.m. to 7:00 p.m. The **central tendency** will most likely indicate the highest traffic occurring at 5:00 PM.

This study will identify weekly traffic patterns on Washington Street. Using this information, we can determine whether expansion of the road is necessary.



Reading

2 Read this proposal from a civil engineering firm. Then, read the summary of the passage. Fill in the blanks using words from the word bank.

WORD BANK

discard frequency analyze
traffic sort sample

Crane Engineering submitted a proposal to examine **1** _____ patterns. They plan to take a **2** _____ at an intersection for seven days. They will record the **3** _____ of cars that pass by, **4** _____ the data and **5** _____ any number that is too extreme. Finally they will plot the data and **6** _____ it before presenting their findings.

Vocabulary

3 Match the words (1-7) with the definitions (A-G).

1 __ population
2 __ range
3 __ raw data
4 __ frequency
5 __ sort
6 __ statistical quality control
7 __ bell curve

A the use of statistics to examine products
B how often an event occurs in a time period
C the amount between the high and low values of a set
D data that has not been analyzed
E the group that a person studies
F to arrange something in a certain way
G a graph with most data in the middle

4 Choose the word that is similar in meaning to the underlined part.

1 Create a graph that displays the frequency of events.
A population **B** histogram **C** sample

2 Discard any values that vary from the rest of the data.
A outliers **B** bell curves **C** ranges

3 What's the value in the middle of a data set?
A variation **B** central tendency
C statistical quality control

4 Get a group that represents a larger population.
A range **B** histogram **C** sample

5 Why is the difference between values so large?
A variation **B** statistical quality control **C** raw data

5 Listen and read. How often will the number of vehicles be measured each day?

Listening

6 Listen to a conversation between an engineer and a city planner. Mark the following statements as true (T) or false (F).

1 __ Road tube studies cost less than video studies.
2 __ The speakers agree to use video detection devices.
3 __ The woman is unsure what results would show a new road is needed.

7 Listen again and complete the conversation.

Planner: Hi Ms. Roberts. I received **1** _____ _____ today.
Engineer: Great. What are your thoughts?
Planner: We're interested in your services, but we have some questions.
Engineer: Sure. What would you like to know?
Planner: First, how exactly do you plan to **2** _____ _____ _____ _____ for the sample?
Engineer: Well, we have **3** _____ _____ _____ options. We could use road tubes or video detection devices.
Planner: What are the benefits of **4** _____ _____?
Engineer: They're **5** _____ _____. But they're not always reliable. A heavy vehicle could damage the tube.
Planner: What about the video detection devices?
Engineer: They can record **6** _____ _____ _____ information. But they're much more expensive.

Speaking

8 With a partner, act out the dialogue from Task 7. Then switch roles.

USE LANGUAGE SUCH AS:

I received your proposal today.
What are your thoughts?
We have some questions.

Student A: You are a city planner. Student B submits a proposal to study traffic patterns. Ask Student B about:

- collecting data
- benefits of options

Make up a name for the engineer.

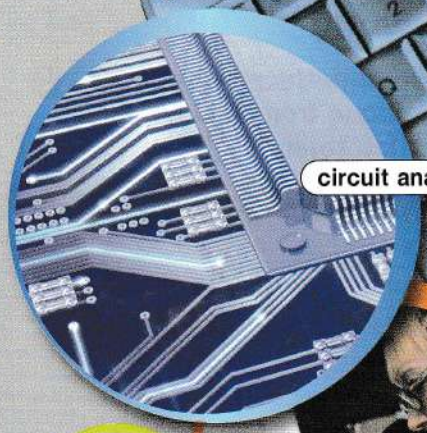
Student B: You are a civil engineer. Answer Student A's questions.

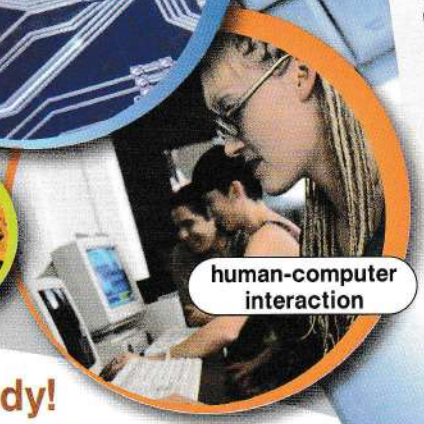
Writing

9 You are a civil engineer conducting a study. Use the proposal and the conversation from Task 8 to write some notes for a presentation (100-120 words). Make sure to write about the following:

- What issue or topic you are studying
- How you are conducting the study
- What results you are expecting to find

11 Computer engineering





PC WORLD Monthly - MARCH

BURLINGTON UNIVERSITY ANNOUNCES COMPUTER ENGINEERING PROGRAM CHANGE

BURLINGTON - Dr. Franklin Boyles, Dean of Engineering at Burlington University, has announced that the university's computer engineering program will expand next year. The university already offers basic concentrations in areas such as **computer networking** and **software engineering**. Boyles stated that the Department of Engineering will begin offering concentrations in the more complex fields of **digital signal processing** and **VLSI** design. Concentrations in **algorithms** and **circuit analysis** are set to be added as well.

Entirely new degree programs will also be offered. These include Bachelor of Science degrees in **robotics** and **artificial intelligence**. Master's degrees will also be offered in **fault-tolerant computer system** design, **human-computer interaction**, and **control engineering**. Boyles believes that all of these fields will be very important in the future. "As space exploration becomes more advanced, students with an in-depth knowledge of these areas will be in high demand," he said. There are currently no plans to add any new doctoral programs. Burlington's Department of Engineering is already known worldwide for its doctoral program in **interactive systems engineering**, though.

This is the single largest expansion in the school's history. It sends a clear message that Burlington University plans on becoming a world leader in the area of computer engineering.

Get ready!

1 Before you read the passage, talk about these questions.

1 Why is computer engineering a rapidly expanding field?

2 What kind of work do computer engineers do?

Reading

2 Read this newspaper article. Then, choose the correct answers.

1 What is the article mostly about?
- **A** changes in the field of computer design
- **B** the university's new computer building
- **C** why computer courses are changing
- **D** the areas the department is expanding into

2 Which of the following will NOT be offered as a master's degree?
- **A** control engineering
- **B** human-computer interaction
- **C** interactive systems engineering
- **D** fault-tolerant computer system design

3 What can be inferred about the university?
- **A** It has not been a leader in engineering.
- **B** It just founded an engineering school.
- **C** It is most well-known for its law school.
- **D** It is the largest university in the region.

Vocabulary

3 Check (✓) the sentence that uses the underlined parts correctly.

1 ___ **A** Artificial intelligence lets machines make decisions.
___ **B** Studying algorithms helps us understand electricity.

2 ___ **A** Digital signal processing involves interpreting signals.
___ **B** Engineers use VLSI to create software.

3 ___ **A** Fault-tolerant computer systems fail often.
___ **B** Computer networking lets computers share data.

4 ___ **A** Robotics allows machines to build cars.
___ **B** Control Engineering implements software.

5 ___ **A** Software engineering uses sensors and actuators.
___ **B** Improving human-computer interaction makes computer use easier.

4 Match the words (1-7) with the definitions (A-G).

1 __ control engineering
2 __ fault-tolerant computer system
3 __ interactive systems engineering
4 __ software engineering
5 __ algorithm
6 __ circuit analysis
7 __ VLSI

A a system that functions even if parts fail
B the process of combining thousands of circuits on one chip
C a set of instructions for solving a problem
D the discipline that studies voltage and currents in networks
E the discipline that uses sensors and actuators to control systems
F the discipline that creates software
G an interdisciplinary field that combines many disciplines

5 Listen and read. What new undergraduate degrees will be offered at Burlington?

Listening

6 Listen to a conversation between a reporter and the dean. Mark the following statements as true (T) or false (F).

1 __ The Engineering Department is larger than most school's.
2 __ The university expects to attract better students.
3 __ Fault-tolerant computer system design is a key area.

7 Listen again and complete the conversation.

R: Why are you expanding the **1** _____ _____ _____?
D: Well, our **2** _____ has been smaller than those of **3** _____ _____ for decades.
R: So you think this expansion will help the university?
D: Yes, I believe it will bring **4** _____ _____ students to Burlington.
R: Why?
D: We'll be giving them more opportunities to excel in **5** _____ _____.
R: Tell me about some of those new opportunities.
D: Sure. We're going to be offering master's degrees in three key new areas, including **6** _____ _____ computer system design.
R: Why have you identified that as a "key" area?
D: Advanced space travel will require advances in computer engineering. For a spacecraft to be reliable enough for long-distance travel, it would need fault-tolerant computer systems.
R: Interesting. What about some of the new bachelor's degrees?
D: Those are also very exciting. Personally, I find artificial intelligence to be the most attractive. We're going to focus initially on reasoning and problem solving.

Speaking

8 With a partner, act out the dialogue from Task 7. Then switch roles.

USE LANGUAGE SUCH AS:

So you think this expansion will ...?

Why have you identified that as a "key" area?

Tell me about some of those new opportunities.

Student A: You are talking to a dean about changes to the Engineering Department. Talk to Student B about:

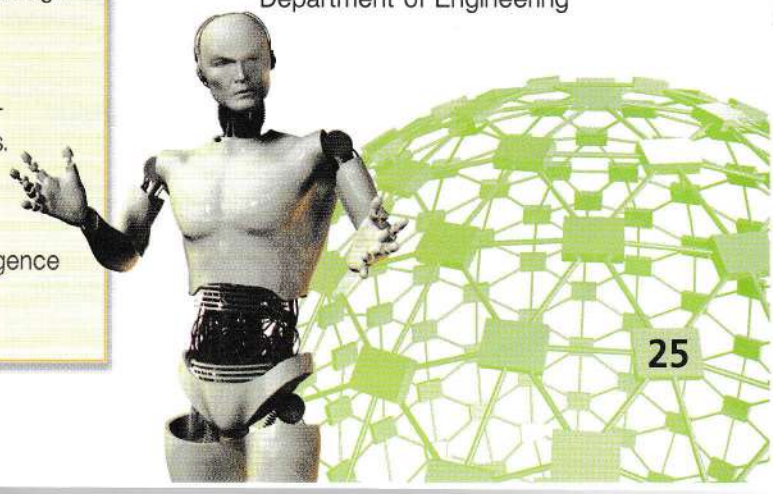
- expansion
- degrees or programs to be added
- why those areas are important

Student B: You are the dean. Answer Student A's questions.

Writing

9 You just interviewed the dean. Use the article and the conversation from Task 8 to write an article about what the dean said to you (100-120 words). Write about:

- Why the expansion is happening
- How the expansion will help the university
- What will be added to the Department of Engineering



12 Materials engineering


offshore


well


drilling

Hire Engineers

http://www.hireengineers.com

Geological Engineer

Description: DrillCo needs engineers with an extensive knowledge of **geology** and **geophysics** to supervise its **drilling** operations. Successful candidates will need to coordinate with drillers, drilling engineers, geologists and reservoir engineers at the **well**. They must ensure that the drilling occurs as planned. The engineers must be aware of any geological safety risks that drilling causes. The position also requires **mud logging** skills as successful candidates will examine the rocks and sediment brought up during the process.

Petroleum Engineer

Description: EXtract, Inc. wants engineers trained in the process of acquiring **petroleum** from beneath the Earth's surface. They must ensure that the highest amount of petroleum possible is extracted. Drilling can be performed both **onshore** and **offshore**. Engineers must be well-versed in **wellbore hydraulics** as drilling continues. Exceptional candidates will be chosen to oversee the process from **refining** through distribution.

Plastics Engineer

Description: Plastix Solutions is looking for engineers to create products from **polymers**. They must know not only the **raw material** that goes into the creation of plastics, but also typical processes like **injection molding** and **extrusion**. Because of the focus on product creation, experience in **research and development** is essential.


onshore


geophysics

Get ready!

1 Before you read the passage, talk about these questions.

1 Why do some materials engineers have to be knowledgeable about geology?

2 How do you think materials will change in the future?

Reading

2 Read the job listings for engineers. Then, choose the correct answers.

1 What are all of these companies looking for?
- A drilling experts
- B specialized materials engineers
- C engineers from different disciplines
- D people with research experience

2 DrillCo need a geological engineer to
- A work with raw materials.
- B analyze the wellbore hydraulics.
- C ensure geological safety of the project.
- D manage the refining process.

3 What can you infer about EXtract, Inc.?
- A It engages in mud logging.
- B It performs services besides drilling.
- C It drills offshore more than onshore.
- D It is owned by a petroleum refining company.

Vocabulary

3 Match the words (1-11) with the definitions (A-K).

1 __ injection molding
2 __ offshore
3 __ geology
4 __ wellbore hydraulics
5 __ geophysics
6 __ extrusion
7 __ onshore
8 __ mud logging
9 __ polymer
10 __ well
11 __ petroleum

- A in the ocean; underwater
- B a fossil fuel
- C the study of the Earth's movements
- D plastics and other synthetic materials
- E the process of shaping objects with molds
- F the study of fluids in drilling holes
- G the shaping of something by pushing it through a die
- H a hole created by drilling
- I the examination of rock raised by drilling
- J on land
- K study of the Earth's physical matter

4 **Use the words from the word bank to fill in the blanks.**

WORD BANK

refining drilling raw materials
research and development

1 Engineers in _____ create new products.
2 They're _____ to find petroleum.
3 Petroleum is unusable until after the _____ process.
4 Factories take _____ and turn them into usable products.

5 **Listen and read. Where are the three jobs advertised?**

Listening

6 **Listen to the conversation between an interviewer and an engineer. Mark the statements as true (T) or false (F).**

1 __ The engineer majored in Chemical Engineering.
2 __ The engineer interned in a plastics factory.
3 __ The engineer dislikes research and development.

7 **Listen again and complete the conversation.**

Interviewer: First of all, thank you for applying for the 1 _____ _____ position.
Engineer: Thank you for interviewing me.
Interviewer: Let's start off with your experience. So, you majored in 2 _____ _____ in college?
Engineer: That's right, but I focused on polymers and plastics.
Interviewer: And your first job was at a factory?
Engineer: Well, I interned for a while in college and 3 _____ _____ _____ before I got a real job.
Interviewer: So you know the 4 _____, but we want more than that. How good are you with innovation?
Engineer: Oh, 5 _____ _____ _____ is actually one of my passions.
Interviewer: Is that so? Tell me about it.
Engineer: One of my first projects when I officially started working was trying to create more 6 _____ _____.

Speaking

8 **With a partner, act out the dialogue from Task 7. Then switch roles.**

USE LANGUAGE SUCH AS:

Thank you for applying.
Let's start off with your experience.
And your first job was at a factory?

Student A: You are interviewing a plastics engineer. Talk to Student B about:

- education
- job experience
- innovation

Student B: You are a plastics engineer. Answer Student A's questions.

Writing

9 **Your company is hiring a new engineer. Use the job listings and the conversation from Task 8 to write a job posting. Write about:**

- What tasks the job entails
- What professional characteristics the candidates should have
- What personal characteristics the candidates should have

13 Environmental engineering

SEWAGE TREATMENT PROJECT

The city of Hudson currently has plans to build a **sewage treatment facility** to treat its waste water. This **impact assessment** report examines the potential effects of this facility on the **environment**.

The sewage facility will draw in waste water from industrial and residential buildings. It will then treat the water through a process of **detoxification**. Finally, the facility will direct the treated water back out into nearby bodies of water.

Such a process may pose a risk to the **flora** and **fauna** living in nearby lakes. For example, a leak or spill from the facility's storage tanks can create sewage **runoff**. This runoff contains **hazardous** compounds that may enter the nearby lakes and streams. If extensive **pollution** enters these **habitats,** the plants and animals that live in them could be threatened.

However, some **mitigation** measures are available to reduce the chances of such problems occurring. The least expensive option is to install special storage tanks that help contain spills. Another option is to use alternative treatment methods in place of using potentially harmful chemicals.

Such measures will eliminate the amount of harmful compounds that can enter nearby lakes and streams. This will aid in the **conservation** of many important plant and animal **species**.

Get ready!

1 Before you read the passage, talk about these questions.

1 What kind of activities can harm the environment?

2 How can engineers improve the environment?

Reading

2 Read this report from the Center for Environmental Protection. Then, choose the correct answers.

1 What is the passage mostly about?

A the advantages of conserving species

B the reaction to a sewage treatment facility

C a proposed sewage facility and its effects

D reasons not to construct a sewage facility

2 What can be inferred from the report?

A The city will announce the system next week.

B Runoff has damaged flora and fauna in Hudson.

C The city fears that the treated water may pollute the area.

D Alternative treatments are more costly than containment tanks.

3 Which of the following is NOT correct?

A The city plans to clean the polluted water from factories.

B The facility must clean polluted environments.

C There is a treatment method that does not use chemicals.

D Mitigation techniques can reduce possible harm.

Vocabulary

3 Match the words (1-8) with the definitions (A-H).

1 __ runoff
2 __ detoxification
3 __ hazardous
4 __ fauna
5 __ mitigation
6 __ environment
7 __ flora
8 __ pollution

A the animal species existing in an area

B the land and water where people, plants, and animals exist

C the process of removing harmful materials

D excess liquid that flows along the ground

E the process of limiting harmful effects

F harmful or dangerous

G the contamination of air and water

H the plant species in an area

4 Read the sentences and choose the correct meaning of the underlined word(s).

1 Many different <u>species</u> of snakes live in this river.
- **A** the plant life that lives in an area
- **B** plants or animals that share characteristics
- **C** excess liquid

2 <u>Conservation</u> is important to Carl.
- **A** evaluating the environmental effects
- **B** protecting wildlife and the environment
- **C** limiting the harmful effects of activities

3 The city's <u>sewage treatment facility</u> is safe.
- **A** plant that cleans waste water
- **B** land and water
- **C** process of removing harmful substances

4 The ape was released into a natural <u>habitat</u>.
- **A** plant that cleans waste water
- **B** excess liquid
- **C** area where a plant or animal lives

5 Listen and read. What is the cheapest way to deal with potential problems at the plant?

Listening

6 Listen to a conversation between two engineers. Mark the following statements as true (T) or false (F).

1 ___ The woman recommends alternative treatment methods.

2 ___ The ultraviolet light lamps need little maintenance.

3 ___ Special tanks and leak detection sensors provide the best solution.

7 Listen again and complete the conversation.

Engineer 1: Emily, did you see this report about the **1** _____ _____ facility?

Engineer 2: Yes, I just read it.

Engineer 1: What **2** _____ _____ _____ of the mitigation measures?

Engineer 2: Well, many facilities are switching to alternative treatment methods. Like the use of ultraviolet light for **3** _____.

Engineer 1: Do you think that would work for the Hudson plant?

Engineer 2: It could. But I don't think it's **4** _____ _____ _____.

Engineer 1: Why not?

Engineer 2: The lamps require lots of maintenance. And you have to **5** _____ _____ frequently.

Engineer 1: So it's fairly expensive?

Engineer 2: Yes, both the installation and maintenance would **6** _____ _____ _____.

Speaking

8 With a partner, act out the dialogue from Task 7. Then switch roles.

USE LANGUAGE SUCH AS:

What do you think of the mitigation measures?

I don't think it's the best option.

So it's fairly expensive?

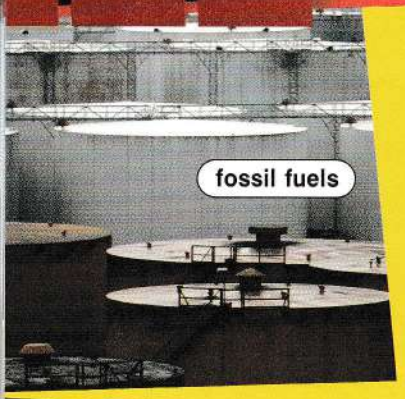
Student A: You want an engineer's opinion on a sewage facility. Ask Student B about:
- mitigation measures
- costs

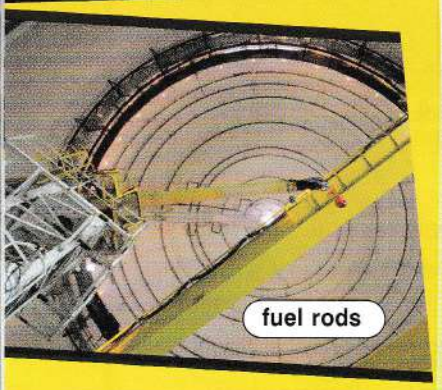
Student B: You are an environmental engineer. Answer Student A's questions.

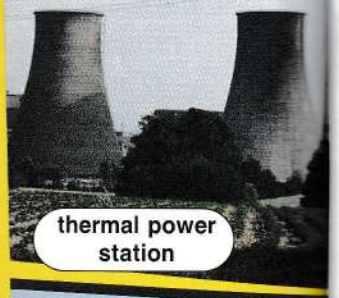
Writing

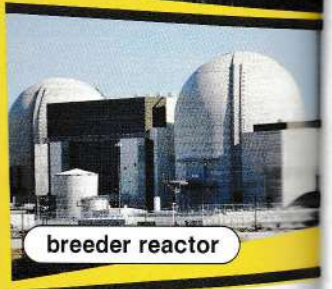
9 You are assessing a new sewage treatment facility. Use the report and the conversation from Task 8 to write a brief evaluation of the facility. Write about:
- How the sewage treatment facility would work
- Potential environmental effects
- Available mitigation measures

14 Nuclear engineering







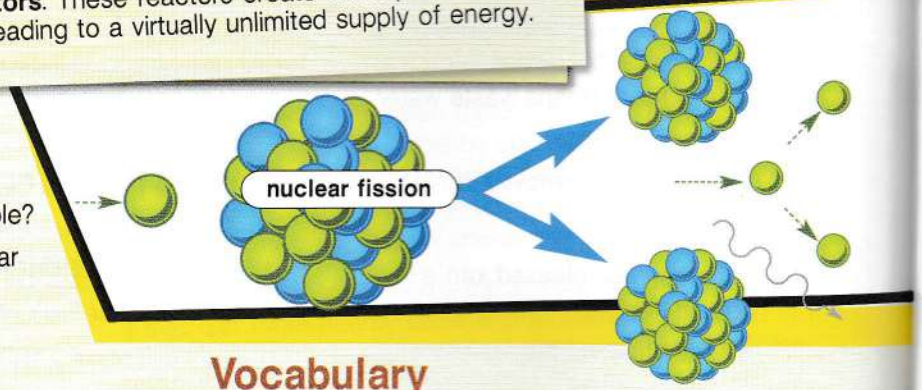


Energy Tomorrow *Vol. 4, No. 17*

Cleaning Up Nuclear Power: Reprocessing Spent Fuel Rods

The business of making energy has traditionally been a dirty one. Modern nuclear power plants are changing this however, since they do not emit harmful pollutants into the air like conventional **thermal power stations** do. This is because they do not burn **fossil fuels** to create **thermal energy**. Instead, they harness the energy that comes from **nuclear fission**. Unfortunately, this is not a totally harmless proposition. The biggest issue that arises from this process comes from the waste that is left over after a nuclear reaction. Luckily, there is a relatively simple solution to this problem.

Spent nuclear fuel rods are left over after **fissile** material such as **uranium-235** or **plutonium-239** is used to create a **nuclear chain reaction** within a power plant. These **radioactive** rods are usually buried in the ground, contaminating the area far into the future. There is another option, however. Reprocessing these fuel rods allows the plutonium and unburned uranium in the rods to be dissolved, separated, and used again as fuel in a nuclear reactor. Interestingly, after being used in conventional reactors, these reprocessed fuel rods could then be used in special **breeder reactors**. These reactors create more plutonium than they use up, leading to a virtually unlimited supply of energy.



Get ready!

1 Before you read the passage, talk about these questions.

1 Why might nuclear power be desirable?
2 What are some ways to make nuclear power safer?

Reading

2 Read this magazine article. Then, choose the correct answers.

1 What is the article mostly about?
- A the science of nuclear chain reactions
- B methods for obtaining new uranium-235
- C the dangers of using plutonium-239
- D the benefits of nuclear power and fuel rod reprocessing

2 What is created by breeder reactors?
- A fossil fuels
- B plutonium
- C uranium
- D pollutants

3 What can be inferred about spent nuclear fuel rods?
- A They are useless in breeder reactors.
- B They cannot be buried in the ground.
- C They are very expensive to reprocess.
- D They can be extremely dangerous.

Vocabulary

3 Match the words (1-9) with the definitions (A-I).

1 __ radioactive
2 __ fissile
3 __ fossil fuel
4 __ fuel rod
5 __ plutonium-239
6 __ breeder reactor
7 __ thermal power station
8 __ thermal energy
9 __ nuclear chain reaction

- A capable of being split
- B a non-uranium isotope that is usable as fuel
- C a fuel that is created by dead organisms
- D a power plant using steam to create power
- E emitting radiation
- F a reactor that creates new fissile material faster than it consumes fissile material
- G energy created by increased molecular activity
- H an object composed of fissile material
- I a series of nuclear reactions

4 **Write a word that is similar in meaning to the underlined part.**

1 The fuel the only fissile isotope that is found in great quantities in nature.
_ _ a _ i _ m - 2 _ _

2 A nuclear reaction that splits an atom into smaller parts is the basis of nuclear power.
_ u _ _ _ _ r f _ _ _ i _ n

3 The process of dissolving used nuclear fuel rods prevents contamination.
_ _ _ r _ c _ _ s _ _ g

5 🎧 **Listen and read. Why is it a bad idea to store used nuclear fuel in the ground?**

Listening

6 🎧 **Listen to an interview between two nuclear engineers. Mark the following statements as true (T) or false (F).**

1 __ The woman thinks reprocessing fuel rods is too expensive.
2 __ The man thinks reprocessing fuel rods is dangerous.
3 __ The engineers agree that reprocessing fuel rods has environmental benefits.

7 🎧 **Listen again and complete the conversation.**

Engineer 2: Well, I think it's **1** _____ _____. I don't think reprocessing fuel rods is a good idea.
Engineer 1: I think it's a great idea! Why don't you like it?
Engineer 2: **2** _____ _____ _____, it's dangerous. **3** _____ from spent fuel rods can be used to make nuclear weapons.
Engineer 1: I suppose, but I'm sure they would be careful to **4** _____ _____ _____.
Engineer 2: That may be, but I also disagree with it because of the expense.
Engineer 1: The expense?
Engineer 2: Yeah! Just going out and finding **5** _____ in the ground is not cheap!
Engineer 1: That may be, but reprocessing fuel rods is a much more efficient way of getting new **6** _____ _____.
Engineer 2: How do you figure that?
Engineer 1: It's simple. Those breeder reactors create more plutonium than they use up!

Speaking

8 **With a partner, act out the dialogue from Task 7. Then switch roles.**

USE LANGUAGE SUCH AS:

I don't think reprocessing fuel rods ...

I think it's a great idea! Why don't you like it?

Those breeder reactors create ...!

Student A: You want to know what an engineer thinks about fuel rod reprocessing. Talk to Student B about:

- opinion about reprocessing
- support for opinion

Student B: You are a nuclear engineer. Answer Student A's questions.

Writing

9 **You are trying to decide whether or not you support nuclear fuel rod reprocessing. Use the article and the conversation from Task 8 to write about its pros and cons (100-120 words). Write about:**

- Why nuclear fuel rod reprocessing is potentially dangerous
- How nuclear fuel rod reprocessing helps the environment
- How nuclear fuel rod reprocessing is more efficient than finding new uranium-235

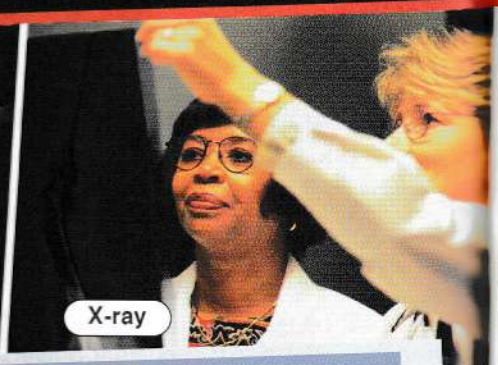
15 Biomedical engineering

Get ready!

1 Before you read the passage, talk about these questions.

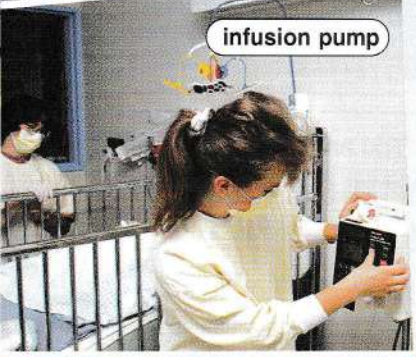
1 What do biomedical engineers do?
2 What are the benefits of biomedical engineering?

respirator



X-ray

ultrasound



infusion pump

BioCare Provides Medical Solutions

BioCare offers a variety of products for both **treatment** and **diagnosis** in the medical industry. Our biomedical engineers work around the clock to create the best healthcare technology.

For the hospital bed, we can provide **respirators** for artificial breathing. Our **infusion pumps** provide patients with the necessary medication, nutrients and fluids when other options aren't available. Infusion times can be programmed in doses or initiated and stopped by the patient.

For patients in need of **implants** and **prosthetic** devices, we offer both artificial organs and artificial limbs. For example, our artificial **pacemakers** ensure that the heart keeps beating.

We've also developed expert medical devices for surgeons and technicians like the **heart-lung machine** for cardiopulmonary bypasses and **dialysis** machines for weakened kidneys.

Likewise, BioCare has made great strides in **medical imaging**. Our **MRI** machines are unparalleled, while our new BioCare2000 **CT** scanners use **X-rays** to create the best 3D images possible with 256 **slices**. Our **ultrasound** machines offer superior imaging to diagnose and monitor patients, especially with prenatal medicine. And once a baby is born, we have only the best postnatal care products available. Our **incubators** ensure that premature infants develop as safely as possible.

Human life is precious. Make sure it stays safe with BioCare.

Reading

2 Read these product descriptions from a biomedical engineering firm. Then, choose the correct answers.

1 What does BioCare provide?
- **A** medical treatment
- **B** hospital equipment
- **C** biological research
- **D** diagnostic consulting

2 Which of the following does NOT create an image?
- **A** X-ray
- **B** incubator
- **C** ultrasound
- **D** CT scanner

3 What can you infer about infusion pumps?
- **A** They control the heart rate.
- **B** They are available in two models.
- **C** They deliver only medication.
- **D** They serve patients who cannot eat.

Vocabulary

3 Match the words (1-9) with the definitions (A-I).

1 __ heart-lung machine
2 __ incubator
3 __ MRI
4 __ respirator
5 __ X-ray
6 __ ultrasound
7 __ CT scan
8 __ infusion pump
9 __ implant

- **A** a device that helps a person breathe
- **B** the use of radiation to create a 3D image
- **C** a device that administers fluids, and medicine
- **D** a device that aids respiration and circulation
- **E** a device that sound waves to create an image
- **F** a device that uses radio waves and magnetic fields to create images
- **G** a device that protects premature infants
- **H** an artificial object placed inside the body
- **I** the use of radiation to create an image on film

4 Fill in the blanks with the correct words: *dialysis, diagnosis, pacemaker, medical imaging, prosthetic, treatment.*

1 The _____ revealed that his condition was not serious.
2 He had a _____ installed after his heart attack.
3 Patients with kidney failure need _____ machines.
4 _____ limbs help people who have lost arms and legs.
5 _____ allows doctors to see inside patients.
6 Robert's _____ is working, so he'll recover quickly.

5 Listen and read. Where are Biocare's ultrasound machines particularly useful?

Listening

6 Listen to a conversation between a doctor and an engineer. Mark the following statements as true (T) or false (F).

1 __ The speakers have talked about the scanner before.
2 __ The new CT scanner offers more slices than any other scanner.
3 __ The BioCare2000 subjects patients to more radiation than a 64 slice scanner.

7 Listen again and complete the conversation.

Engineer: Hello, this is Frank Janson at BioCare. I'm 1 _____ _____ _____ for Dr. Ellen Baker.
Doctor: Hi Frank, this is Ellen. Thanks for calling me back.
Engineer: 2 _____ _____. What can I do for you?
Doctor: I have a few questions about that new 3 _____ _____ _____ _____.
Engineer: Yes, the BioCare2000. What can I tell you?
Doctor: Well, I see that it offers 4 _____ _____. Is that really possible?
Engineer: It is. We're the only manufacturer that offers such a high number.
Doctor: I know. The most I've ever seen is a 5 _____ _____ scanner.
Engineer: And that's not bad. But with 256 slices, you'll get a clearer picture than ever before.
Doctor: I would imagine so! But with so many slices, aren't we 6 _____ _____ _____ _____?
Engineer: Are you talking about the radiation?
Doctor: Exactly. More slices must mean more X-rays, right?
Engineer: Actually, it's just the opposite. With our improvements, the new unit uses fewer X-rays than a 64 slice scanner.

Speaking

8 With a partner, act out the dialogue from Task 7. Then switch roles.

USE LANGUAGE SUCH AS:

What can I do for you?
I see that it offers...
We're the only manufactures that ...

Student A: You curious about a new CT scanner. Ask Student B questions to find out about:

- slices
- radiation

Student B: You are a biomedical engineer. Answer Student A's questions.

Create names for the engineer and the doctor.

Writing

9 You are a biomedical engineer. Use the product description and the conversation from Task 8 to recommend new equipment to a doctor (100-120 words). Write about:

- What biomedical equipment your firm offers
- What the benefits of these devices are

Glossary

3-D [ADJ-U8] If something is **3-D (dimensional)**, it exhibits or appears to exhibit the three dimensions of height, width, and depth.

absolute zero [N-UNCOUNT-U2] **Absolute zero** is 0 degrees Kelvin (or -273.15 degrees Celsius) and the theoretical minimum point of entropy. All processes would cease in a system that has reached absolute zero.

acceleration [N-UNCOUNT-U1] **Acceleration** is an increase in an object's speed.

algorithm [N-COUNT-U11] An **algorithm** is a method for solving a problem by using a specified sequence of instructions.

analog computer model [N-COUNT-U8] An **analog computer model** is a computer model created on an analog computer system. While much more limited than digital computers, analog computers are still capable of running long and complex computer models and simulations.

anode [N-COUNT-U5] An **anode** is an electrode that allows electric current to flow into an electrical device such as a battery.

artificial intelligence [N-UNCOUNT-U11] **Artificial intelligence** is the discipline concerned with the creation of machines capable of perceiving their surroundings and reacting accordingly.

assemble [V-TRANS-U7] To **assemble** something is to put it together.

base unit [N-COUNT-U6] A **base unit** is one of the seven basic units of measurement that make up the SI system of units.

battery [N-COUNT-U5] A **battery** is a combination of one or more electrochemical cells used to store chemical energy that it converts to electrical energy when it is needed.

bell curve [N-COUNT-U10] A **bell curve** is a graph in which most values lie around a middle value.

breeder reactor [N-COUNT-U14] A **breeder reactor** is a nuclear reactor that creates new fissile material at a faster rate than it consumes fissile material. It is capable of using less nuclear fuel and creating less waste while still creating the same amount of energy as a normal nuclear reactor.

candela [N-COUNT-U6] A **candela** is a unit of measurement for luminous intensity.

cathode [N-COUNT-U5] A **cathode** is an electrode that allows electric current to flow out of an electrical device such as a battery.

central tendency [N-UNCOUNT-U10] The **central tendency** of a group of data is the value that lies in the middle of the group.

charge [V-I-U5] To **charge** something is to supply it with electric current for the purpose of storing energy.

circuit analysis [N-UNCOUNT-U11] **Circuit analysis** is the discipline concerned with studying and identifying the voltage and currents that run across and through every component of a given network.

computer networking [N-UNCOUNT-U11] **Computer networking** is the discipline concerned with the communication between computer systems or devices.

conductor [N-COUNT-U5] A **conductor** is a material that allows the flow of electric current.

conservation [N-UNCOUNT-U13] **Conservation** is the process of protecting the environment and the plants and animals that live there.

conservation of energy [N-UNCOUNT-U2] **Conservation of energy** is the concept that the energy in a system cannot be created or destroyed, it can only be changed. The system will always have the same amount of energy, even if it changes form.

conserved quantity [N-COUNT-U9] **Conserved quantity** is the amount that remains unchanged.

constraint [N-COUNT-U7] A **constraint** is a limit set on what can be done.

construct [N-COUNT-U7] To **construct** something is to build it.

consumption [N-UNCOUNT-U9] **Consumption** is the amount of extensive quantity destroyed during a given period.

control engineering [N-UNCOUNT-U11] **Control engineering** is the discipline concerned with using sensors and actuators to control systems with predictable behaviors.

criteria [N-UNCOUNT-U7] **Criteria** are standards by which to judge something.

CT [N-UNCOUNT-U15] **CT** (computed tomography) is use of a series of X-rays and computers to create a 3D image.

current [N-UNCOUNT-U5] A **current** is a flow of electrons or ions.

derived unit [N-COUNT-U6] A **derived unit** is a unit of measurement formed by combining various base units.

detailed design [N-COUNT-U7] A **detailed design** is a version closely resembling what the final product looks like.

detoxification [N-UNCOUNT-U13] **Detoxification** refers to the process of removing harmful substances from something.

diagnosis [N-COUNT-U15] **Diagnosis** is the act of identifying an illness.

dialysis [N-UNCOUNT-U15] **Dialysis** is the purification of blood as a substitute for a kidney.

diameter [N-COUNT-U3] The **diameter** of a circle is the distance across its widest point.

digital computer model [N-COUNT-U8] A **digital computer model** is a computer model created on a digital computer system. It is used to show a system in part or in entirety, and is capable of performing incredibly complex calculations at a very high speed.

digital signal processing [N-UNCOUNT-U11] **Digital signal processing** is the discipline concerned with the representation and processing of digital signals.

drilling [N-UNCOUNT-U12] **Drilling** is the act of making a hole in the earth.

driving force [N-COUNT-U3] A **driving force** is the power that causes an object to start or continue moving.

dynamics [N-UNCOUNT-U4] **Dynamics** is the study of the causes of motion.

electrode [N-COUNT-U5] An **electrode** is an electrical conductor used to make contact with a nonmetallic part of a circuit.

empirical [ADJ-U8] If something is **empirical**, it has been gained by observation or experience.

entropy [N-UNCOUNT-U2] **Entropy** is a measure of how organized or disorganized a system is. A system experiencing increasing entropy is experiencing greater disorganization.

environment [N-COUNT-U13] The **environment** is all the land and water where people, plants, and animals exist.

equilibrium [N-UNCOUNT-U2] **Equilibrium** is the condition wherein competing influences are balanced.

evaluate [V-TRANS-U7] To **evaluate** something is to test it and see if it meets expectations.

extensive quantity [N-COUNT-U9] An **extensive quantity** is an amount that can rise and fall.

extrusion [N-UNCOUNT-U12] **Extrusion** is the shaping of something by pushing it through a die.

fault-tolerant computer system [N-COUNT-U11] A **fault-tolerant computer system** is a computer system capable of continuing to function even if certain faults develop with it.

fauna [N-UNCOUNT-U13] **Fauna** refers to the various animal life existing in a certain area.

feasibility study [N-COUNT-U7] A **feasibility study** is an evaluation of the difficulty of a proposed project.

First Law of Thermodynamics [N-UNCOUNT-U2] The **First Law of Thermodynamics** is the expression of the concept of conservation of energy as a scientific law.

fissile [ADJ-U14] If something is **fissile**, it is capable of being split. In nuclear engineering, this refers to the splitting of atoms necessary to create a nuclear chain reaction.

flora [N-UNCOUNT-U13] **Flora** refers to the various plant life existing in a certain area.

flow rate [N-COUNT-U3] The **flow rate** of a liquid is the volume that passes through a given area in a certain amount of time.

flux [N-UNCOUNT-U3] **Flux** is the amount of something that passes through a cross-sectional area in a given amount of time.

fossil fuel [N-COUNT-U14] A **fossil fuel** is a fuel such as coal or oil that is created by the decomposition of dead organisms.

free body diagram [N-COUNT-U4] A **free body diagram** is a visual representation of forces acting upon a body.

frequency [N-UNCOUNT-U10] **Frequency** is the number of times an event occurs in a given period of time.

friction [N-UNCOUNT-U1] **Friction** is a force that causes resistance when two objects come into contact, or when an object comes into contact with air.

fuel rod [N-COUNT-U14] A **fuel rod** is an object composed of fissile material that can be used to create energy in a nuclear reactor.

generation [N-COUNT-U9] **Generation** is the amount of extensive quantity produced during a given period.

geology [N-UNCOUNT-U12] **Geology** is the study of the Earth's physical matter.

Glossary

geophysics [N-UNCOUNT-U12] **Geophysics** is the study of the Earth's physical movements.

gram [N-COUNT-U9] A **gram** is a unit of measurement for mass.

habitat [N-COUNT-U13] A **habitat** is a specific area where a plant or animal lives.

hazardous [ADJ-U13] Something that is **hazardous** is harmful or dangerous.

heart-lung machine [N-COUNT-U15] A **heart-lung machine** is a pump that takes over the functions of the heart and lungs during a cardiopulmonary bypass.

heat [N-UNCOUNT-U2] **Heat** is the process of energy transfer from one body or system to another.

histogram [N-COUNT-U10] A **histogram** is a graph that displays the frequency of different events.

human-computer interaction [N-UNCOUNT-U11] **Human-computer interaction** is the discipline concerned with the study of relations between humans and computers.

IDEF [N-UNCOUNT-U8] **IDEF (Integrated Definition)** is a family of modeling languages used to model data.

identify [V-TRANS-U7] To **identify** something is to recognize it.

impact assessment [N-UNCOUNT-U13] **Impact assessment** is to the process of evaluating the effects that an activity will have on the environment.

implant [N-COUNT-U15] An **implant** is a tissue or artificial object put inside a person's body.

incubator [N-COUNT-U15] An **incubator** is an enclosed device that protects and helps a premature baby develop.

inertia [N-UNCOUNT-U1] **Inertia** is a force that keeps an object in the same position.

infusion pump [N-COUNT-U15] An **infusion pump** is a device that administers fluids, medication and nutrients into the body.

injection molding [N-UNCOUNT-U12] **Injection molding** is the insertion of plastic into a mold to shape it.

inlet [N-COUNT-U3] An **inlet** is something that allows the entrance of something else. The part of a hose that allows water to enter the hose is an inlet, for example.

input [N-COUNT-U9] **Input** is the extensive quantity added to a system.

insulator [N-COUNT-U5] An **insulator** is a material that does not allow the flow of electric current.

intensive quantity [N-COUNT-U9] An **intensive quantity** is a physical characteristic of an object.

interactive systems engineering [N-UNCOUNT-U11] **Interactive systems engineering** is an interdisciplinary field that combines the disciplines of software engineering, psychology, ethnography, and many others. It analyzes communication between humans and machines, between machines, and between humans through machines.

internal energy [N-UNCOUNT-U2] **Internal energy** is the energy possessed by a substance due to the movement of its molecules and its potential energy.

Kelvin [N-UNCOUNT-U2] **Kelvin** is a system of measuring temperature wherein zero degrees Kelvin is equal to absolute zero.

lithium [N-UNCOUNT-U1] **Lithium** is a soft, silver metal that is used as an anode in lithium batteries.

load [N-COUNT-U4] A **load** is a force applied to a structure.

luminance [N-UNCOUNT-U6] **Luminance** measures the luminous intensity that the human eye can perceive across a certain amount of area.

luminous intensity [N-UNCOUNT-U6] **Luminous intensity** measures the power of light the human eye can perceive being emitted in a direction.

magnitude [N-COUNT-U4] **Magnitude** is the size of something.

mass [N-UNCOUNT-U1] **Mass** is the amount of matter an object has.

mathematical model [N-COUNT-U8] A **mathematical model** is something that uses mathematics to describe a system such as population growth or traffic patterns.

measurement [N-COUNT-U6] A **measurement** is a specification of a particular property, such as size, weight, or time.

medical imaging [N-UNCOUNT-U15] **Medical imaging** is the creation of pictures of the body to examine or diagnose a disease.

mitigation [N-UNCOUNT-U13] **Mitigation** is the process of limiting the harmful effects of activities on the environment.

modeling language [N-COUNT-U8] A **modeling language** is a language that is used to express information about a system or structure within the constraints of specific rules. The rules are used to help interpret the meaning of different components of the system or structure being analyzed.

moment [N-COUNT-U4] **Moment** is the ability of a force to cause an object to turn on an axis.

motion [N-UNCOUNT-U1] **Motion** refers to the state of an object when it is moving.

MRI [N-UNCOUNT-U15] **MRI** (magnetic resonance imaging) uses radio waves and magnetic fields to produce images.

mud logging [N-UNCOUNT-U12] **Mud logging** is the examination of rocks brought to the surface by drilling.

narrow [V-TRANS-U7] To **narrow** something is to make it less wide.

net force [N-COUNT-U1] A **net force** is the sum of all the forces acting on an object.

Newton's first law [N-UNCOUNT-U1] **Newton's first law** is a law that states that objects will remain at rest or moving in a straight line unless a net force acts upon them.

Newton's second law [N-UNCOUNT-U1] **Newton's second law** is a law that states that force is equal to mass times acceleration.

Newton's third law [N-UNCOUNT-U1] **Newton's third law** is a law that states that each action has an equal and opposite reaction.

nuclear chain reaction [N-COUNT-U14] A **nuclear chain reaction** is a series of nuclear reactions wherein one splitting atom leads to another splitting atom and so on. A nuclear chain reaction releases millions of times more energy than the most powerful chemical reaction.

nuclear fission [N-UNCOUNT-U14] **Nuclear fission** is a nuclear reaction wherein the nucleus of an atom is split into smaller parts. This process releases a large amount of energy.

offshore [ADJ-U12] When something is **offshore** it is underwater.

onshore [ADJ-U12] When something is **onshore** it is on land.

outlet [N-COUNT-U3] An **outlet** is something that allows the exit of something else. The part of a hose that allows water to exit the hose is an outlet, for example.

outlier [N-COUNT-U10] An **outlier** is a value in a set of data that varies significantly from the rest of the data.

output [N-COUNT-U9] **Output** is the extensive quantity leaving the system.

pacemaker [N-COUNT-U15] A **pacemaker** is a device that controls a heart's contractions.

path quantity [N-COUNT-U9] A **path quantity** is dependent on the course of a process.

petroleum [N-UNCOUNT-U12] **Petroleum** is a liquid found under the earth's surface and used to create fuel.

physical model [N-COUNT-U8] A **physical model** is a lifelike recreation of a planned or existing physical object, usually made to a smaller scale.

plutonium-239 [N-CUNOUNT-U14] **Plutonium-239** is a fissile isotope and the only non-uranium isotope that has been proven to be usable as fuel in a nuclear reactor. It is commonly used in the construction of nuclear weapons.

Poiseuille equation [N-UNCOUNT-U3] The **Poiseuille equation** allows one to calculate the pressure drop of a liquid as it flows through a long cylinder such as a pipe or a hose.

pollution [N-UNCOUNT-U13] **Pollution** is the contamination of air, water, etc. from harmful substances.

polymer [N-COUNT-U12] A **polymer** is a large molecular structure, usually used to describe plastics and other synthetic materials.

population [N-COUNT-U10] A **population** is the total group of people or things that a person draws inferences about.

portable [ADJ-U4] When something is **portable** it can be carried around.

positive temperature coefficient [N-COUNT-U5] The **positive temperature coefficient** of an object is a measure of the object's increase in electrical resistance when its temperature is increased.

preliminary design [N-COUNT-U7] **Preliminary design** is the initial look of a product.

pressure [N-UNCOUNT-U3] **Pressure** is the force per unit area applied to an object.

prosthetic [N-COUNT-U15] A **prosthetic** is an artificial limb or organ.

Glossary

qualitative model [N-COUNT-U8] A **qualitative model** is a model used to see how things interact with or react to one another.

radioactive [ADJ-U14] If something is **radioactive**, it is emitting radiation as the result of changes in its nuclei. Radioactivity can be very dangerous and potentially lethal.

range [N-COUNT-U10] A **range** is the amount between the lower and upper limits of a set of values.

rate [N-COUNT-U3] A **rate** is a the amount a certain quantity changes in a given amount of time.

raw data [N-UNCOUNT-U10] **Raw data** refers to data that one has not analyzed or manipulated in any way.

raw material [N-COUNT-U12] A **raw material** is the basic substance from which something is made.

refining [N-UNCOUNT-U12] **Refining** is the act of making something more usable by making it pure.

reprocessing [N-UNCOUNT-U14] **Reprocessing** is the process of dissolving used nuclear fuel in order to chemically separate the components found in it. These components can then be used again as fuel in a nuclear reactor.

research and development [N-UNCOUNT-U12] **Research and development** (or R & D) is work done to improve or innovate products.

resistance [N-UNCOUNT-U3] **Resistance** is a force that opposes motion. Friction is a type of resistance.

respirator [N-COUNT-U15] A **respirator** is a device that controls a person's breathing when that person cannot breathe alone.

rest [N-UNCOUNT-U1] **Rest** refers to the state of an object when it is not moving.

rigid body [N-COUNT-U4] A **rigid body** is a structure ignoring any changes to it from applied force.

robotics [N-UNCOUNT-U11] **Robotics** is the discipline concerned with the design, manufacture, and implementation of machines capable of performing tasks on their own.

runoff [N-UNCOUNT-U13] **Runoff** is excess liquid that flows on the ground and often contains dirty substances.

safety factor [N-COUNT-U4] **Safety factor** is a structure's ability to withstand a load.

sample [N-COUNT-U10] A **sample** is a group that someone studies to determine characteristics of a larger population.

Second Law of Thermodynamics [N-UNCOUNT-U2] The **Second Law of Thermodynamics** is the expression of the concept of entropy as a scientific law. It states that a system that is not in equilibrium will tend to increase in entropy and become more disorganized over time.

separator sheet [N-COUNT-U5] A **separator sheet** is a sheet of plastic that keeps a battery's electrodes from touching while still allowing energy to pass through it in the form of ions.

sewage treatment facility [N-COUNT-U13] A **sewage treatment facility** is a building that collects and treats waste water in order to remove dirty substances.

SI system of units [N-UNCOUNT-U6] The **SI system of units** is a particular system of units of measurement. It gives values for seven base units.

simulation [N-COUNT-U8] A **simulation** is an imitation or prediction of a real object or event. When created on a computer, a simulation is essentially the same thing as a computer model.

sketch [N-COUNT-U7] A **sketch** is a drawing of something.

slice [N-COUNT-U15] A **slice** is an image created by an MRI or CT scanner that shows a thin cross-section of a body.

software engineering [N-UNCOUNT-U11] **Software engineering** is the discipline of creating, modifying, and implementing software.

solid angle [N-COUNT-U6] A **solid angle** is a two-dimensional angle in a sphere.

sort [V-T-U10] To **sort** data is to arrange or group it in a certain way.

species [N-COUNT-U13] A **species** is a particular group of plants or animals that share similar characteristics and can breed together.

square meter [N-COUNT-U6] A **square meter** is a unit of measurement of area.

stability [N-COUNT-U4] **Stability** is the ability not to change or fail.

state quantity [N-COUNT-U9] A **state quantity** is independent of the course of a process.

statics [N-UNCOUNT-U4] **Statics** is the study of bodies at rest and forces in equilibrium.

statistical quality control [N-UNCOUNT-U10] **Statistical quality control** refers to the use of statistical methods to examine and improve the quality of a product.

steady state [N-COUNT-U9] A **steady state** is a system where the amount going into a system is the same as the amount leaving it over a given period.

steradian [N-COUNT-U6] A **steradian** is a unit of measurement for solid angles.

superfluid [N-COUNT-U3] A **superfluid** is a description of heat capacity wherein unusual characteristics are observed in a fluid. These characteristics include the ability to creep up the walls of a container until the container is completely empty.

supplementary unit [N-COUNT-U6] A **supplementary unit** is an additional measurement unit included in the SI system of units.

system [ADJ-U6] A **system** is a set of separate but interacting bodies that together form a whole.

system [N-COUNT-U9] A **system** is a section of the world that an engineer monitors.

temperature [N-UNCOUNT-U2] **Temperature** is the measure of the kinetic energy of particles in matter. A material that contains particles that are moving faster or of greater mass will appear to be warmer than a material that contains particles that are moving more slowly or are of less mass.

thermal energy [N-UNCOUNT-U14] **Thermal energy** is the energy resulting from the movement of a substance's constituent parts.

thermal power station [N-COUNT-U14] A **thermal power station** is a power plant in which steam is used to turn a turbine and create power. Thermal power stations can include anything from coal-fired power plants to nuclear power plants.

third Law of Thermodynamics [N-UNCOUNT-U2] The **Third Law of Thermodynamics** deals with the limits of entropy. It states that a system cannot ever reach the minimum value of entropy, which is absolute zero.

treatment [N-COUNT-U15] **Treatment** is care for an illness or injury.

trasound [N-UNCOUNT-U15] **Ultrasound** is the use of sound to create an image.

ML [N-UNCOUNT-U8] **Unified Modeling Language** is a general-purpose modeling language used to make visual models of systems.

iversal accounting equation [N-UNCOUNT-U9] The **universal accounting equation** is: Final Amount - Initial Amount = Input - Output + Generation - Consumption

anium-235 [N-UNCOUNT-U14] **Uranium-235** is an isotope of uranium that is known for being the only fissile isotope that is found in great quantities in nature. It is therefore commonly used in nuclear reactors.

riation [N-UNCOUNT-U10] **Variation** refers to the measure of difference between values in a set of data.

ctor [N-COUNT-U1] A **vector** is a quantity that has both a size and a direction.

locity [N-UNCOUNT-U1] **Velocity** refers to the speed that something travels at.

nt hole [N-COUNT-U5] A **vent hole** is a hole that exists in a battery, to release pressure from inside the battery if it is building up to an unsafe degree.

rify [V-TRANS-U7] To **verify** something is to prove that it is correct.

ration [N-COUNT-U4] **Vibration** is a series of rapid movements back and forth.

cosity [N-COUNT-U3] The **viscosity** of a liquid is the measure of its resistance to being deformed through pouring or other movement. The higher the viscosity, the more it resists being deformed.

SI [N-UNCOUNT-U11] **Very Large-Scale Integration** is the process of combining thousands of circuits into a single computer chip.

ML [N-UNCOUNT-U8] **Virtual Reality Modeling Language** is a modeling language used to create 3-D graphics.

ll [N-COUNT-U12] A **well** is a hole created by drilling.

llbore hydraulics [N-UNCOUNT-U12] **Wellbore hydraulics** is the study of the motion of fluids in a well.

ray [N-COUNT-U15] An **X-ray** is a type of radiation that can pass through objects and show the structures inside them on special film.

CAREER PATHS

Engineering

Career Paths: Engineering is a new educational resource for engineering professionals who want to improve their English communication skills in a work environment. Incorporating career-specific vocabulary and contexts and reviewed by leaders within the engineering industry, each unit offers step-by-step instruction that immerses students in the four key language components: reading, listening, speaking, and writing. ***Career Paths: Engineering*** addresses topics including tools, materials, numbers, engineering concepts, converting measurements, and career options.

The series is organized into three levels of difficulty and offers over 400 vocabulary terms and phrases. Every unit includes a test of reading comprehension, vocabulary, and listening skills, and leads students through written and oral production.

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- A variety of realistic reading passages
- Career-specific dialogues
- 45 reading and listening comprehension checks
- Over 400 vocabulary terms and phrases
- Guided speaking and writing exercises
- Complete glossary of terms and phrases

The **Teacher's book** contains a full answer key and audio scripts.
The **audio CDs** contain all recorded material in American English and British English.

Books 1-3 of ***Career Paths: Engineering*** are rated for the Common European Framework of Reference for Languages at A1, A2 and B1 respectively.

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