UNIT 6

PHYSICAL SCIENCE
NANOTECHNOLOGY

Unit Description

Content: This course is designed to familiarize the student with concepts in nanotechnology.

Skills: Fact and Opinion
- Identifying and evaluating information presented to support a position
- Recognizing a speaker’s degree of certainty
- Distinguishing between facts and opinions
- Expressing and supporting opinions

Unit Requirements

- Lecture: “The New Small Is Big”
- Readings: “Micro Materials That Could Pose Major Health Risks” (from The Globe and Mail, M. Mittelstaedt)
  “Study Says Carbon Nanotubes as Dangerous as Asbestos” (from Scientific American, L. Greenemeier)
- Integrated Speaking Task: Preparing and delivering a short oral report about applying precautionary principle to nanotechnology
- Assignments: www.MyAcademicConnectionsLab.com
Contents

1 PREVIEW
   Previewing the Academic Content
   Previewing the Academic Skills Focus

2 BUILDING ACADEMIC LISTENING SKILLS
   Before You Listen
   Global Listening
   Focused Listening

3 BUILDING ACADEMIC READING SKILLS
   Before You Read
   Global Reading
   Focused Reading

4 BUILDING ACADEMIC SPEAKING SKILLS
   Before You Speak
   Focused Speaking
   Integrated Speaking Task

GRAMMAR CHART: Modals: Expressing Degrees of Certainty

UNIT 6 ANSWER KEY
1 PREVIEW

Go to www.MyAcademicConnectionsLab.com for Vocabulary Check.

Previewing the Academic Content, page 114

Physical science is the study of the physical world and covers topics, such as weather, Earth, the solar system, metals, and atoms. Almost all physical science programs specialize in a certain discipline within the field, such as chemistry, physics, geology, or astronomy. Nanotechnology, the study of the control of matter on an atomic and molecular scale, deals with structures at a size of 100 nanometers (one nanometer = one billionth of a meter) or smaller and involves developing materials or devices of that size. Nanoscience and nanotechnology programs focus on developing the knowledge and understanding of nanoscale phenomena and applying nanoscience in order to control nanometric processes. Individuals with a graduate degree in nanoscience or nanotechnology can become research scientists, nanoengineers, nanoscience professors, and more.

In this unit, students will examine:

- the precautionary principle as it relates to the field of nanotechnology
- the science of nanotechnology and its applications in today’s world
- the potential risks of products that contain nanoparticles

Activating Background Knowledge

Before students read and study about nanotechnology, explore with them what they know about the field of nanotechnology.

- What does the word nanotechnology mean? If no one knows, have them guess at the meaning by looking at the individual parts of the word:
  - nano = 1 billionth (students may be able to connect nano to the small but popular MP3 player with that name)
  - tech = informal for technical
  - (o)logy = the study of
- Nanotechnology focuses on the control and manipulation of minuscule particles that are less than 1 billionth of a meter.
- What are some of the implications of the ability to manipulate these minuscule particles?

Go to www.MyAcademicConnectionsLab.com for Key Words and Key Words: Practice.
Previewing the Academic Skills Focus, page 115

Highlight the purpose of this section, stated on the left. This unit focuses on strategies for:

- distinguishing between fact and opinion
- recognizing a speaker's or writer's degree of certainty
- expressing and supporting an opinion

The introduction mentions a nanometer. This word is pronounced nan-uh-me-ter (the a in nan is short like the a in apple).

The text in this section comes from an Internet FAQ sheet created by the Science and Environmental Health Network. The precautionary principle is the idea that if an activity, such as a new technology, has the potential to harm human or environmental health, precautions must be taken to prevent that harm. The usefulness of this approach is controversial. The implication is that waiting for scientific certainty before taking preventative measures may be unwise, because often the evidence of harm comes too late. For example by the time scientific data showed that smoking was harmful, many smokers had died.

Further, humans have an ethical responsibility to protect, preserve, and restore the ecosystems on which all life depends.

Review the academic skills focus: Fact and Opinion, page 116.

Go to www.MyAcademicConnectionsLab.com for Comprehension.

Go to www.MyAcademicConnectionsLab.com for Discussion Board.

2 BUILDING ACADEMIC LISTENING SKILLS

Go to www.MyAcademicConnectionsLab.com for Vocabulary Check.

Highlight the purpose of this section, stated on the left. Tell students that they will learn to identify and evaluate information presented in support of a position. They will also learn to recognize the degree of certainty of a speaker presenting an opinion.
Before You Listen, page 118

Students learn how to evaluate the reliability of information presented in support of a position, begin to examine the potential of nanomaterials, and become familiar with scientific terms and vocabulary related to the lecture.

Review the academic skills focus: Identifying and Evaluating Information Presented to Support a Position.

It may be hard for students to comprehend the size of a nanoparticle. To provide a frame of reference as they scan the diagram for Exercise 2, page 119, point out that the head of a pin measures about 2 millimeters. One nanometer is one millionth of a millimeter. A red blood cell (depicted in the diagram) is 7,000 nanometers.

Before students begin Exercise 3, page 120, model the pronunciation of the Key Words on page 120. Students may particularly have difficulty with:

- **min-us-cule** (the second syllable is stressed and pronounced just like the pronoun *us*)
- **i-on** (the *i* is long, like the *i* in *like*; stress is on the first syllable); *ion* is often confused with *eon* (pronounced with long *e*), which refers to a length of time or a geologic time period

This vocabulary will be helpful for comprehension of the lecture and useful for the Integrated Speaking Task.

Go to www.MyAcademicConnectionsLab.com for Key Words and *Key Words: Practice*.

Global Listening, page 122

Students listen to a lecture about nanotechnology and take notes about some basic information in the lecture.

- Examine the Key Words on page 122. This vocabulary will be helpful for comprehension of the lecture.
- Before students listen to the beginning of the lecture, go over the questions in Exercise 1, page 122.
- Before students listen to the whole lecture, call their attention to the chart on page 122. Point out that they are listening for information about two main ideas in the lecture and that these two ideas correspond to the two headings in the chart.
Summary of the Lecture

“The New Small Is Big,” page 122 (For the complete audioscript, see Academic Connections 4, pages 190–191.)

- The prefix *nano* means “one billionth,” so a nanometer is one billionth of a meter, about the length of six atoms.
- *Nanotechnology* is the science of how molecules and atoms can be used to make new materials, machines, and processes and how tiny particles can be used to improve the quality of life.
- In 1959, physicist and Nobel Laureate Richard Feynman began the nanotechnology revolution with a speech.
  - Feynman argued that small machines are more efficient and cheaper to make than larger ones, so scientists should look for new ways to use very small particles, e.g., perform surgery, store data, generate power.
  - Feynman’s idea was inspirational, but researchers had no tools to work on a minuscule scale.
  - In 1990, the atomic force microscope was invented, and this opened the door for the invention of very tiny things.
- The most significant nanoscale objects are fullerenes and nanotubes. Made from carbon atoms, they are strong, light, flexible, tolerate heat, and can conduct electricity.
- A nanotube looks like a sheet of chicken wire with the thickness of only one atom, rolled into a tube.
  - Nanotubes are already in many products we buy, such as car parts, tennis rackets, skis, bike frames, lotions, makeup, and hair products.
  - They are used in clothing to prevent wrinkling or staining. Silver nanoparticles in a washing machine can disinfect clothing.
- Nanotechnology has important applications in electronics. Big companies are trying to shrink computer chips to molecular size so that they won’t melt as the silicon chips of today do.
- Nanotechnology has important applications in medicine. A fullerene—a spherical nanoparticle—could be filled with medicine and attached to a molecule that would connect only with bacteria, defective genes, or cancer cells. This would allow the medicine to be sent to an exact site, eliminating its side effects.

Focused Listening, page 122

Students listen to members of a study group discussing the benefits and risks of nanotechnology and to a number of students discussing the lecture. They learn how to recognize a speaker’s degree of certainty, using specific collocations that indicate degrees of certainty.

Review the academic skills focus: Recognizing a Speaker’s Degree of Certainty.

As you go over the chart on page 123, point out to students that the second section of the chart differs from the first and third because it includes expressions that use unlikely, the antonym of likely. While likely means that there is approximately 50 percent certainty that something will happen, unlikely means that there is about 80 percent certainty that something won’t happen.

Summary of the Study Group Discussion, page 123

(For the complete audioscript, see Academic Connections 4, page 192.)

• **Student 1** thinks nanotechnology is exciting and is certain it will transform the fields of medicine, electronics, and manufacturing.
• **Student 2** thinks there are always risks with new technology and that it’s possible there are risks associated with nanotechnology.
• **Student 3** has read some literature that discusses the application of nanotechnology to medicine. It’s possible that nanotechnology could result in new cancer treatments.
• **Student 4** thinks that even if there are some drawbacks to nanotechnology, there is only a slight possibility that these drawbacks will prevent further development of nanotechnology.
• **Student 5** thinks that there is a good possibility that there are implications of this new technology that haven’t been considered yet.

Summary of the Students’ Conversation about the Lecture, page 124

• **Student 1** says nanotechnology is being used in many common consumer products, such as cosmetics and clothing.
• **Student 2** notes that if tiny machines could be made out of nanoparticles, they would require less power and be cheaper to make.
• **Student 3** doubts that something as small as nanotechnology can have such a large impact on our lives.
• **Student 4** thinks nanoparticles will be used to cure cancer and expresses certainty that they will one day save the world.
Highlight the purpose of this section, stated on the left. Tell students that they will read about some of the health risks of nanomaterials and practice distinguishing facts from opinions.

**Before You Read**, page 124

Students work in groups to discuss some of the uses, benefits, and risks of technologies and products that were initially received enthusiastically but were later shown to have toxic effects on people.

- Before students do Exercise 3, page 125, you may want to review the tenets of the precautionary principle on pages 115–116.
- The precautionary principle is the idea that if an activity or an invention, such as a new technology, has the potential to harm human or environmental health, precautions must be taken to prevent that harm. The usefulness of this approach is controversial.
- The implication of the precautionary principle is that waiting for scientific certainty before taking preventative measures may be unwise. Humans have an ethical responsibility to protect, preserve, and restore the ecosystems on which all life depends. Waiting for scientific evidence of harm is unwise because often, the evidence comes too late.
- Examine the Key Words on page 125. This vocabulary will be helpful for comprehension of the text.
Global Reading, page 126

Summary of the Reading


A. In a report from the Council of Canadian Academies, a scientific panel warned the public about a number of products that contain nanomaterials.
1. The panel suggests that these substances may interfere with biological processes by penetrating cells.
2. The panel was asked by Health Canada and other federal agencies to look at what is known about nanomaterials and what changes in regulations should be made to manage their use.
3. The panel concluded that there are insufficient data about the risks of these materials, and that, because of their size, they may interrupt the protective mechanisms of the body and therefore be extremely toxic.
4. Advocates of nanomaterials say they have tremendous potential for improving medicines and manufacturing stronger and more durable products. But the panel’s report warned that there are many things once thought to be harmless, such as PCBs and Agent Orange, that are now considered highly toxic.

B. The use of nanomaterials has become extremely widespread in everyday life.
1. Nanomaterials are manmade substances that can be smaller than a virus.
2. Over the past ten years, they have been used more and more frequently in cosmetics, fabrics, sunscreen, and sports equipment.
3. No one really knows the full range of items that contain nanomaterials. Industry Canada estimated that at least 517 items came into Canada from the U.S. in one recent year.

C. Health Canada, an independent academic advisory group funded by the Canadian government, has not responded to questions about the report. The panel’s members include some of Canada’s leading scientists and international experts on nanomaterials.

D. Scientists create these nanomaterials atom by atom, so that their properties are unlike the matter from which they are created.
1. Example: The graphite in pencils and diamonds is composed of carbon molecules but has completely different characteristics.
2. Example: Titanium dioxide nanoparticles have a crystalline structure that allows light to pass through, but they also absorb ultraviolet light, which makes them perfect for use in sunscreens. Sunscreens have been used for years to reduce the risks of skin cancer without causing health problems. This long-term use suggests that they are harmless.
E. The impact of nanoparticles on the environment is still being investigated. What happens when sunscreens get into the water? Do they harm algae, amphibians, or fish? This research won’t be complete until 2010.

F. Nanomaterials may be highly effective in several fields.
   1. When nano-sized particles are administered with chemotherapy, drug doses could be reduced by about 95 percent without reduction in the effect of the medicine.
   2. However, the panel’s report suggested that because the impact of nanomaterials is still poorly understood, we should be overcautious if there are doubts about the safety of a product. Caution will give scientists time to evaluate potential risks.

G. The panel suggested that a comprehensive assessment of the risks of nanomaterials to health and the environment should be made worldwide.
   1. Loopholes in existing regulations may allow some of the many products that contain nanomaterials being used today to avoid close examination.
   2. Because manufacturers of nanomaterials simply rearrange atoms of a substance into a new shape, the substances themselves are not really new and therefore escape examination as new chemicals.
   3. The report concluded that current regulations are not adequate to identify all the nanomaterials that might need supervision.

Go to www.MyAcademicConnectionsLab.com for Reading Activities 1–4.

**Focused Reading, page 128**

Students learn about distinguishing fact from opinion.

Review the academic skills focus: Distinguishing Between Facts and Opinions.

- Before you review the information in the skills section on page 128, elicit from students what they remember about the distinction between fact and opinion, and record what they say on a T-chart on the board. Students studied this information in the Previewing the Academic Skills Focus section on page 116.
- Go over the information in the skills section and compare it to what the students said.
After students complete Exercise 1, pages 129–130, you may want to have them work in small groups and compare their answers. Have each group make a T-chart with facts listed in the left column and opinions in the right. Then compare T-charts, discussing any differences.

- Go to www.MyAcademicConnectionsLab.com for Reading Activity 5.
- Go to www.MyAcademicConnectionsLab.com for Checkpoint 2.

### 4 BUILDING ACADEMIC SPEAKING SKILLS

Make sure that students are familiar with the grammar point covered in MyAcademicConnectionsLab for this unit (modals: expressing degrees of certainty) before they begin this section. Go to page 14 in these Teacher's Notes for the grammar chart.

- Go to www.MyAcademicConnectionsLab.com for Grammar Check.

Highlight the purpose of this section, stated on the left. Tell students that they will practice using evidence and details to express and support opinions. They will also prepare and deliver a brief oral report about the precautionary principle as it relates to nanotechnology.

**Before You Speak, page 131**

Students read an article about the dangers of nanotubes and practice expressing and supporting opinions in preparation for the Integrated Speaking Task.

**Summary of the Reading**

“Study Says Carbon Nanotubes as Dangerous as Asbestos,” by L. Greenemeier, page 131

- Research posted online by Nature Nanotechnology shows that carbon nanotubes can lead to cancer and their use should be regulated because breathing carbon nanotubes leads to the same cancer and breathing problems that asbestos caused.
Researchers found that long, thin nanotubes resemble and function like asbestos fibers, which are known to cause cancer of membranes that line internal organs, such as the lungs.

These fibers are very harmful because they are too long to be destroyed by the body’s immune system, but small enough to penetrate the lungs deeply.

Cancer can take as long as 30 or 40 years to show up after exposure to asbestos fibers.

After researchers exposed mice to nanotubes, the linings of their body cavities became inflamed and developed sores.

Andrew Maynard, a scientist based in Washington, D.C, has warned about the potential risks of carbon nanotubes since 2003.

His research also focused on the idea that long, thin carbon nanotubes have an impact similar to asbestos fibers.

In the lungs, nanotubes form scarlike tissue, and the body builds new cells on the nanotubes causing the walls of the lungs to thicken.

The researchers don’t intend to stop the development of nanotechnology, but they want to highlight its possible dangers at manufacturing and disposal sites. Maynard points out that it was too late for a lot of people by the time the dangers of asbestos were realized.

Go to www.MyAcademicConnectionsLab.com for Comprehension.

Focused Speaking, page 132

Students practice expressing and supporting an opinion about the precautionary principle.

Review the academic skills focus: Expressing and Supporting Opinions.

After small groups have discussed the topics in Exercise 1, page 132, have each group share its ideas with the whole class. This discussion can lead into a whole group discussion of whether the precautionary principle should be applied to the development of nanotechnology.

Before pairs begin to complete the chart on page 133, you may want to have students listen to the lecture one more time, adding to the notes they took previously and their answers to the questions on page 122.

Integrated Speaking Task, page 133

The Integrated Speaking Task requires students to apply the knowledge they have acquired in this unit in order to prepare an oral report.

- Go over the Integrated Speaking Task assignment on page 133. Remind students that their introductions should have a thesis statement that introduces the topic and clearly expresses an opinion without using expressions such as I think or In my opinion. The thesis statement should also outline the main points of the report.
- Review Step 1 on page 133. You may want students to have a complete thesis statement before they go on to the next step.
- Review Steps 2 and 3. You may want to assign the preparation of the report as homework.
- For Step 4, page 134, you can have students work in pairs or small groups to give each other feedback using the checklist on page 134.
- Allow time for students to revise their reports, either in class or at home before they present their reports to the class.

Go to www.MyAcademicConnectionsLab.com for Internet Activity and Academic Words Puzzle.
# GRAMMAR CHART: Modals: Expressing Degrees of Certainty

<table>
<thead>
<tr>
<th>Modals: Expressing Degrees of Certainty</th>
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<tbody>
<tr>
<td><strong>Modals and modal-like expressions</strong> can be used to express how certain we are about something. They are used to speculate or make predictions about things based on logic and facts as we understand them.</td>
</tr>
<tr>
<td><strong>Affirmative</strong></td>
</tr>
<tr>
<td>must, should, ought to</td>
</tr>
<tr>
<td>have (got) to</td>
</tr>
<tr>
<td>may</td>
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<tr>
<td>might, could</td>
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</table>

1. **Use must / have to / have got to + base form of the verb** when you are almost certain (about 95 percent) that something is **true**.

   If your shirt doesn’t wrinkle, it **must / has (got) to mean** that it contains nanoparticles.

   Wrinkle-resistant clothing **can’t / couldn’t be** possible without nanoparticles.

   If so many scientists oppose nanotechnology, it **must not be** safe.

   If you’re making goods that can affect people’s lives, they **mustn’t be** dangerous. (= **they shouldn’t be allowed to be dangerous**)

   Nanotechnology is **the science of the future**.

2. **Use may / might / could + base form of the verb** when you are less certain (about 50%). Note that may, might, and could have almost the same meaning, but may means that something is a little more possible than might and could.

   The clothes you are wearing now **may contain** nanoparticles. (50% certain)

   The clothes you are wearing now **might / could contain** nanoparticles. (< 50% certain)

   Products that contain nanoparticles **may not / might not be** safe for people’s health after all.

**Note:** Don’t contract **must not** when you use it to express certainty.

To express 100 percent certainty, use a verb. Do not use a modal.
3. Use *must have / had to have* + past participle when you are speculating about the past and are almost certain (95%).

To form a negative, use *can’t have / couldn’t have* + past participle to express high degree of certainty. Use *must not have* + past participle when you are slightly less certain.

**Working on particles**: *must have / had to have been* difficult in the past.

**Nanotechnology**: *can’t have / couldn’t have been* possible without the atomic force microscope.

<table>
<thead>
<tr>
<th>4. When you are less certain about something in the past (50% or less), use <em>may have / might have / could have</em> + past participle. Note that <em>may, might, and could</em> have almost the same meaning, but <em>may</em> means that something is a little more possible than <em>might</em> and <em>could</em>.</th>
</tr>
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<tbody>
<tr>
<td><strong>Products with nanoparticles</strong> <em>may have affected</em> people’s health already, but the results won’t be obvious for a while. (50% certain)</td>
</tr>
<tr>
<td><strong>Products with nanoparticles</strong> <em>might have / could have affected</em> people’s health already, but the results won’t be obvious for a while. (&lt;50% certain)</td>
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To form a negative, use *may not have / might not have* + past participle.

**Nanotechnology**: *may not have / might not have been developed*, if the atomic force microscope hadn’t been invented.

**Products with nanoparticles** *could have affected* people’s health already. (= *It’s a possibility—degree of certainty*)

**Nanotechnology** *could have been studied* more closely. (= *It wasn’t—missed opportunity*)

<table>
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<tr>
<th>5. When you are almost certain about a future action or event, use <em>should / ought to</em> + base form of the verb.</th>
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<tbody>
<tr>
<td><strong>Scientists</strong>: <em>should / ought to be</em> able to develop a better delivery system for cancer medicines.</td>
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<table>
<thead>
<tr>
<th>6. When you are less certain about a future action or event, use <em>may / might / could</em> + base form of the verb.</th>
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<tbody>
<tr>
<td><strong>Nanosubstances</strong>: <em>may / might / could put</em> people’s lives in dangers if their use isn’t monitored.</td>
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</table>

**We**: *may / might never know* the effects of nanoparticles on people’s health.

To form a negative, use *may / might + not / never* + base form of the verb.
UNIT 6 ANSWER KEY

1 PREVIEW

Previewing the Academic Content

Exercise 2, page 115
1. Answers will vary.
2. Students might mention the following long-term risks and negative consequences, some of which are hinted at in the introductory paragraph on page 114:
   • possibility that nanoparticles may affect human health
   • possibility of danger in the production of nanoparticles
   • difficulty of recognizing negative consequences connected to the use of new technologies soon enough to prevent damage
   • lack of knowledge about how nanoparticles “decompose”; how they will affect the environment, e.g., what will they do in land-fill sites?
   • lack of knowledge about how nanoparticles might be recycled
3. Answers will vary.

Previewing the Academic Skills Focus

Exercise 2, page 117

Exercise 3, page 117
The Science and Environmental Health Network’s website states (July 2008) that the precautionary principle is the idea that when health and/or the environment may be endangered by an event or technology, it is important to eliminate any possibility of danger, even if a causal relationship between the event and a possible danger has not yet been proven.
Exercise 4, pages 117–118
1. a, c, e, g, i
2. Example 1
3. Answers will vary. Students should use some of the following expressions:
   I believe that . . . , I think that . . . , It seems to me that . . . , In my view . . . , As far as I’m concerned . . .

2 BUILDING ACADEMIC LISTENING SKILLS

Before You Listen

Exercise 2, pages 119–120
1. False; The more divisions of the cube, the more surface area.
2. False; A red blood cell is 7,000 nanometers.
3. True
4. True

Exercise 3, page 120
Scientific Nouns
molecule: The smallest unit into which any substance can be divided without losing its own chemical nature
atom: The smallest part of an element that can exist alone or that can combine with other substances to form a molecule
particle: A small piece of something
ion: An atom that has been given a positive or negative force by adding or subtracting an electron

Adjectives That Mean Small
tiny: Extremely small
minuscule: So small it is hard to see; minute

Noun That Is a Metal
mercury: A heavy, silver-white poisonous metal that is liquid at ordinary temperatures and is used in thermometers (chemical symbol: Hg)

Noun Related to Electrical Systems
circuit: The complete circle that an electric current travels

Word Related to Winning a Prize
Nobel Laureate: Someone who has won a Nobel Prize (a prize given each year to people who have done significant work in various fields, such as physics, chemistry, literature, etc.)
Global Listening

Exercise 1, page 122
1. A nanometer is one billionth of a meter.
2. Nanotechnology and nanoscience are about how molecules do things.
3. Small machines would work more efficiently because they use less power and are cheaper to manufacture.
4. It allowed scientists to manipulate atoms and molecules, allowing them to work on the nanoscale.

Exercise 2, page 122
Characteristics of Nanoparticles
- strong
- light
- flexible
- heat tolerant
- can conduct electricity

Uses of Nanotechnology
- Car parts (such as dashboards and tires) and sporting equipment (such as tennis racquets, skis, bike frames) that contain nanoparticles are stronger and lighter.
- Lotions and creams that contain nanoparticles penetrate more quickly and more deeply. Makeup that contains nanoparticles lasts longer.
- Clothes that contain nanoparticles do not need ironing and do not stain.
- Washing machines use silver ions to kill bacteria, viruses, algae, and fungi.
- Electronics products will one day use nanoparticles for tiny computer chips that won’t melt.
- Fullerenes, or ball-shaped nanoparticles, will one day be used to deliver medication to bacteria, defective genes, or a cancer tumor inside a patient, thereby eliminating unpleasant side effects of medication.
Focused Listening

Exercise 1, page 123
1. 100 percent
2. > 50 percent
3. > 50 percent
4. < 50 percent
5. > 50 percent

Exercise 2, page 124
1. reliable This sounds reliable as there are examples to support the statement that we are already using nanotechnology.
2. reliable The student quotes Richard Feynman. The student supports his point with a reference to a famous physicist.
3. unreliable This is unreliable information as it does not match with what we have learned in the lecture, and the speaker gives no information to support this statement. It is opinion only.
4. unreliable This information was not in the lecture. It is not supported by examples or any other kind of information.

3 BUILDING ACADEMIC READING SKILLS

Before You Read

Exercise 2, page 125
Students may know other products. Note that these are good examples of how government regulation is now making life safer for most people.

- cigarettes
- thalidamide—the anti-nausea drug given to pregnant women that caused birth defects
- nuclear energy—uranium
- lead paint in children’s toys, on cribs, and walls
- melamine in children's formula and candy (China)
- antifreeze in toothpaste (China)
Exercise 4, page 125

1. table 3. current information 5. thinker 7. once bitten, twice shy 9. permit
2. signal the all clear 4. uncover 6. deconstruct 8. concerned audience 10. prevent damage

Global Reading

Exercise 1, page 126
1. The panel’s report warns that nanomaterials may be able to penetrate cells and interfere with biological processes.
2. The panel consists of sixteen experts, including some of Canada’s leading scientists and top international experts on nanomaterials. It seems to be a reliable source. We should trust this information.
3. Because PCBs and Agent Orange were once “new technologies” that were thought to be safe for use and are now known to be highly dangerous to humans. The report writers are drawing a parallel between the unknown risks of nanomaterials and the once unknown risks of PCBs and Agent Orange. We didn’t use caution with PCBs or Agent Orange when we should have—perhaps we should be more cautious with nanomaterials.

Exercise 2, page 126


Exercise 3, page 126

Answers will vary. Possible answers:
1. It is apparently safe for humans, but we still don’t know the long-term impact of these nanoparticles on the environment. When the nanoparticles in sunscreen get into the water, what effect do they have on algae, amphibians, and fish? The use of this example shows that we don’t really know the long-term impact of the nanoparticles on the environment.
2. Use of nanoparticles, administered at the same time as chemotherapy, might reduce the dose of required chemotherapy drugs by about 95 percent without any reduction in therapeutic effect. This would be a huge advantage for cancer patients. Answers will vary about whether this advantage is worth the unknown risk.
Focused Reading

Exercise 1, page 129

Posts 1 through 4 include facts and opinions. Post 5 is only opinion.

First Post: Fact The text states that at one time, polychlorinated biphenyls (PCBs) and Agent Orange were both thought to be safe for human use; however, now everyone knows that they are dangerous to human health and the environment.

First Post: Opinion I think these are both good examples of what can happen when people, governments, and companies proceed too quickly with technological development. From my perspective, nanoparticles are a new technology with potential for dangerous results, and we should err on the side of caution as we develop them for the market.

Second Post: Fact The reading begins with the following sentence: “A scientific panel has waved a yellow flag in front of a rapidly expanding number of products containing nanomaterials, cautioning that the tiny substances might be able to penetrate cells and interfere with biological processes.”

Second Post: Opinion As far as I’m concerned, the word might is the key word in this sentence. Might indicates that the panel is not sure whether nanomaterials will cause problems or not. Are we going to deny cancer victims the benefits of lower doses of chemotherapy drugs just because some people think there might be problems with nanoparticles? I don’t agree with that. I believe that we should proceed as quickly as possible to exploit the benefits of nanotechnology.

Third Post: Fact We’ve been using titanium dioxide in sunscreens for years, and there haven’t been cancer cases resulting from sunscreen use, or even any proof that sunscreen is damaging the environment—for example the beaches or fish in the water.

Third Post: Opinion How bad could the risks of these tiny particles be? You can’t see them, so how much damage could they cause? . . . It seems to me that these particles are completely safe. If we delay further development of nanotechnology, we are depriving people of the advantages that nanoparticles could provide. Why wait any longer?

Fourth Post: Fact Dr. Sinervo, the dean of the University of Toronto’s faculty of arts and science and the head of this scientific panel, is quoted as saying, “One can argue fairly strongly that some of those products probably should be looked at on a going-forward basis. It’s a new technology. We are concerned.”

Fourth Post: Opinion I am of the opinion that a person in his position knows what he’s talking about. If he thinks there may be risks associated with nanoparticles, then there probably are. It just seems reasonable to look before we leap.

Fifth Post: Fact This post is all opinion. It is unsupported by facts.
Fifth Post: Opinion Nanoparticles are the best thing to ever happen. They will provide us with solutions to problems we already have, and to new problems—ones we haven’t even discovered yet. So if nanoparticles are going to cause problems of some kind, we don’t need to worry about the problems now. Even if nanomaterials cause damage somehow, they also offer the potential to solve those problems later. So we shouldn’t worry. Nanoparticles are as safe as we need them to be.

4 BUILDING ACADEMIC SPEAKING SKILLS

Before You Speak

Exercise, pages 131–132
1. The source of the information in the article is the online version of the journal Scientific American. Scientific American is itself quite reputable, but online versions of periodicals may not always provide reliably accurate information. There’s no right or wrong answer to this question, only students who are more or less wary.
2. Nanotubes and asbestos fibers are similarly shaped, and this study proves that inhalation of nanotubes has the same dangers as inhalation of asbestos fibers.
3. Answers will vary. Students should use one of the collocations that express probability on page 123, e.g., It is highly probably that inhaling nanotubes is dangerous, There is a slight possibility that inhaling nanotubes is dangerous, etc.
4. It is unlikely that the results of this study will prevent the further development of nanotechnology because the benefits are too great.
5. Further study on the harmful effects of manufacturing and using nanotubes is required in the immediate future.

Focused Speaking

Exercise 1, page 132
In all of these situations, there is a benefit and a risk. Some students will think the benefit outweighs the risk, others will think the risk outweighs the benefit. The goal here is for students to develop their opinions about whether the precautionary principle should be applied to the development of nanotechnology.