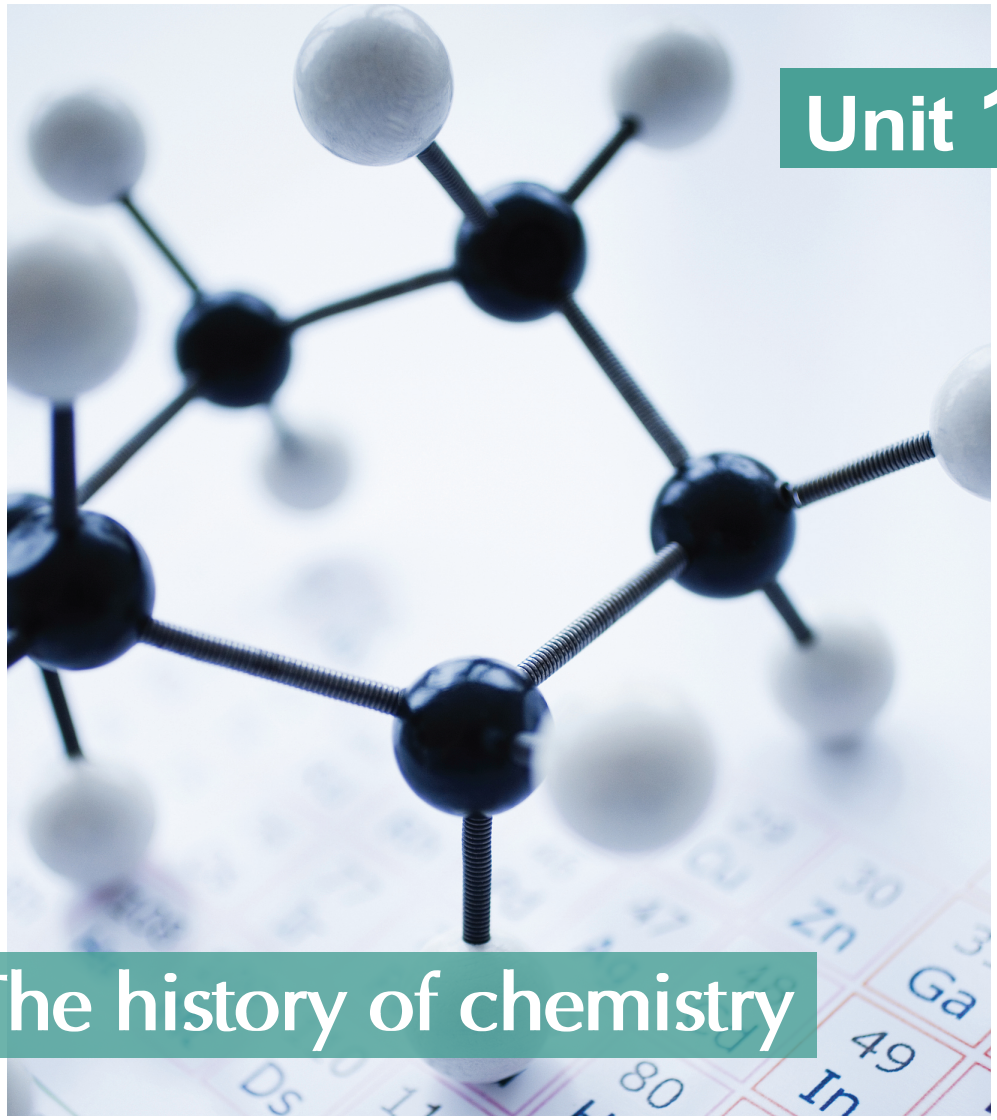


Unit 1

The history of chemistry

In this unit, you will learn:

- **Subject-related knowledge:** The history of chemistry
  Chemical element
- **Academic skill:** Searching for information
- **Reading strategy:** Dealing with unknown words (Part I)

Section A

Pre-reading

1 Read the short passage and fill in the blanks with the words or phrases below. Change the form if necessary.

change combination physical science
reaction rearrange state of matter
undergo various structure

Chemistry is the science of matter and the 1) _____ that occur between different kinds of matter – especially chemical changes when types of matter are 2) _____ into other types of matter. That is, chemistry is a(n) 3) _____ concerned with the composition, structure, behavior, and properties of matter and with changes it 4) _____ during, and as a result of, chemical 5) _____. It involves study of substances in all of the 6) _____ (solid, liquid, and gas) and knowledge and understanding of the 7) _____ of matter (e.g. atoms, molecules, crystals and other aggregates) whether in isolation or in 8) _____ with others.

2 Oral work

1. What are chemistry and chemical engineering in your eyes? How does chemistry influence our life?
2. Why do you choose chemical engineering as your major? What do you want to achieve in your major study?

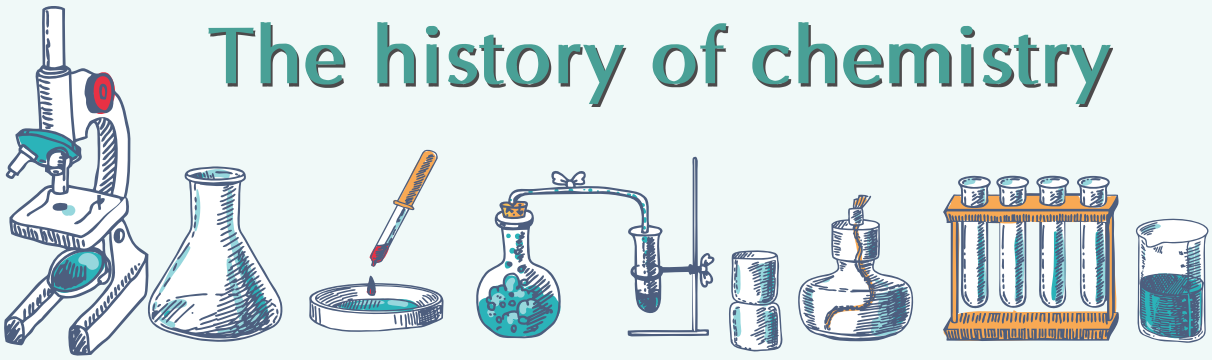
1 The history of chemistry represents a time span from ancient history to the present. By 1000 B.C., civilizations used technologies that would eventually form the basis of various branches of chemistry. Examples include extracting metals from ores, making pottery and glazes, fermenting beer and wine, extracting chemicals from plants for medicine and perfume, rendering fat into soap, making glass, and making alloys like bronze.

2 The protoscience of chemistry, alchemy, was unsuccessful in explaining the nature of matter and its transformations. However, by performing experiments and recording the results, alchemists set the stage for modern chemistry. The distinction began to emerge when a clear differentiation was made between chemistry and alchemy by Robert Boyle in his work *The Sceptical Chymist* (1661). While both alchemy and chemistry are concerned with matter and its transformations, chemists are seen as applying scientific methods to their work.

3 Chemistry is considered to have become an established science with the work of Antoine Lavoisier, who

Text A

The history of chemistry



developed a law of conservation of mass that demanded careful measurement and quantitative observations of chemical phenomena. The history of chemistry is intertwined with the history of thermodynamics, especially through the work of Willard Gibbs.

16th and 17th centuries

4 Practical attempts to improve the refining of ores and their extraction to smelt metals were an important source of information for early chemists in the 16th century, among them Georgius Agricola (1494-1555), who published his great work *De re metallica* in 1556. His work describes the highly developed and complex processes of mining metal ores, metal extraction and metallurgy of the time. His approach removed the mysticism associated with the subject, creating the practical base upon which others could build. The work describes the many kinds of furnace used to smelt ore, and stimulated interest in minerals and their composition. It is no coincidence that he gives numerous references to the earlier author, Pliny the Elder and his *Naturalis Historia*. Agricola has been described as the "father of metallurgy". In 1605, Sir Francis Bacon published *The Proficience and Advancement of Learning*, which contains a description of what would later be known as the scientific method. In 1605, Michal Sedziwój

publishes the alchemical treatise "A New Light of Alchemy", which proposed the existence of the "food of life" within air, much later recognized as oxygen. In 1615 Jean Beguin published the *Tyrocinium Chymicum*, an early chemistry textbook, and in it draws the first-ever chemical equation. In 1637 René Descartes publishes *Discours de la méthode*, which contains an outline of the scientific method.

19th century

5 Throughout the 19th century, chemistry was divided between those who followed the atomic theory of John Dalton and those who did not, such as Wilhelm Ostwald and Ernst Mach. Although such proponents of the atomic theory as Amedeo Avogadro and Ludwig Boltzmann made great advances in explaining the behavior of gases, this dispute was not finally settled until Jean Perrin's experimental investigation of Einstein's atomic explanation of Brownian motion in the first decade of the 20th century.

6 Well before the dispute had been settled, many had already applied the concept of atomism to chemistry. A major example was the ion theory of Svante Arrhenius which anticipated ideas about atomic substructure that did not fully develop until the 20th century. Michael Faraday was another early worker, whose major contribution to chemistry was electrochemistry, in which (among other things) a certain quantity of electricity during electrolysis or electrodeposition of metals was shown to be associated with certain quantities of chemical elements, and fixed quantities of the elements therefore with each other, in specific ratios. These findings, like those of Dalton's combining ratios, were early clues to the atomic nature of matter.

Early 20th century

7 In 1903, Mikhail Tsvet invented chromatography, an important analytic technique. In 1904, Hantaro Nagaoka developed an early planetary model of the atom, where electrons orbit a dense massive nucleus. In 1905, Fritz Haber and Carl Bosch developed the Haber process for making ammonia, a milestone in industrial chemistry with deep consequences in agriculture. The Haber process, or Haber-Bosch process, combined nitrogen and hydrogen to

form ammonia in industrial quantities for production of fertilizer and munitions. The food production for half the world's current population depends on this method for producing fertilizer. Haber, along with Max Born, proposed the Born-Haber cycle as a method for evaluating the lattice energy of an ionic solid. Haber has also been described as the "father of chemical warfare" for his work developing and deploying chlorine and other poisonous gases during World War I.

8 In 1905, Albert Einstein explained Brownian motion in a way that definitively proved atomic theory. Leo Baekeland invented bakelite, one of the first commercially successful plastics. In 1909, American physicist Robert Andrews Millikan – who had studied in Europe under Walther Nernst and Max Planck – measured the charge of individual electrons with unprecedented accuracy through the oil drop experiment, in which he measured the electric charges on tiny falling water (and later oil) droplets. His study established that any particular droplet's electrical charge is a multiple of a definite, fundamental value – the electron's charge – and thus a confirmation that all electrons have the same charge and mass. He spent several years investigating and finally proving linear relationship between energy and frequency proposed by Albert Einstein, providing the first direct photoelectric support for Planck's constant. In 1923 Millikan was awarded the Nobel Prize in Physics.

Late 20th century

9 In 1970, John Pople developed the Gaussian program, greatly easing computational chemistry calculations. In 1971, Yves Chauvin offered an explanation of the reaction mechanism of olefin metathesis reactions. Karl Barry Sharpless and his group discovered stereoselective oxidation reactions including Sharpless epoxidation, Sharpless asymmetric dihydroxylation, and Sharpless oxyamination. In 1985, Harold Kroto, Robert Curl and Richard Smalley discovered fullerenes, a class of large carbon molecules superficially resembling the geodesic dome designed by architect R. Buckminster Fuller. In 1991, Sumio Iijima used electron microscopy to discover a type of cylindrical fullerene known as a carbon nanotube. This material is an important component in the field of nanotechnology. In 1994, Robert A. Holton and his group achieved the first total synthesis of taxol. In 1995, Eric Cornell and Carl Wieman produced the first Bose-Einstein condensate, a substance that displays quantum mechanical properties on the macroscopic scale.

New words and expressions

extract /ɪk'strækt/ *vt.*
to separate a substance from another substance 提取；萃取

ore /ɔː(r) / *n.* 矿；矿石

glaze /gleɪz/ *n.*
coating for ceramics, metal, etc. 釉；光滑面

ferment /'fɜːment/ *vt.*
if food or drink is fermented, a chemical change happens to it and the sugar in it produces alcohol 使发酵

protoscience /ˌprəʊtə'saɪəns/ *n.*
a set of beliefs or theories that have not yet been tested adequately by the scientific method but which are otherwise consistent with existing science 原始科学

alchemy /'ælkɪmɪ/ *n.*
a type of science that people used in the Middle Ages 炼金术

thermodynamics /ˌθɜːməʊdaɪ'næmɪks/ *n.*
the science of the relationship between heat and other forms of energy 热力学

furnace /'fɜːnɪs/ *n.* 火炉；熔炉

metallurgy /me'tælədʒɪ/ *n.*
the scientific study of metals and how they are used 冶金学；冶金术

smelt /smelt/ *vt.*
to extract (metals) by heating 熔炼；冶炼

equation /ɪ'kweɪʒən/ *n.*
a mathematical statement that two expressions are equal 反应式；方程式

proponent /prəʊ'pəʊnənt/ *n.*
a person who publicly supports an idea, policy, plan, etc. 支持者

ion /'aɪən/ *n.* 离子

electrochemistry /ɪˌlektrəʊ'kemɪstrɪ/ *n.* 电化学

electrodeposition /ɪˌlektrəʊˌdepə'zɪʃən/ *n.* 电沉积

chromatography /ˌkrəʊmə'tɒgrəʃɪ/ *n.* 色谱法

nucleus /'njuːklɪəs/ *n.*
(*plural* **nuclei**) 原子核

ammonia /ə'məʊnjə/ *n.* 氨

munitions /mjʊ'nɪʃənz/ *n.*
military weapons and equipment such as guns, bullets, and bombs 军需品；军火

lattice /'lætɪs/ *n.* 晶格；格构

chlorine /'klɔːriːn/ *n.* 氯

bakelite /'beɪkəlaɪt/ *n.* 酚醛塑料

droplet /'drɒplɪt/ *n.* 小滴；微滴

photoelectric /ˌfəʊtəʊɪ'lektrɪk/ *adj.* 光电的

olefin /'əʊlɪfɪn/ *n.* 烯烃

stereoselective /ˌsterɪəʊsɪ'lektɪv/ *adj.* 立体有择的；立体定向的

oxidation /ˌɒksɪ'deɪʃən/ *n.* 氧化（作用）

epoxidation /epɒksɪ'deɪʃən/ *n.* 环氧化作用

dihydroxylation /daɪ-haɪˌdrɒksɪ'leɪʃən/ *n.* 双羟基化反应

oxyamination /ɒksɪəæmɪ'neɪʃən/ *n.* 羟氨基化

fullerene /'fʊlərɪːn/ *n.* 富勒分子

geodesic dome 网格球顶

electron microscopy 电子显微镜

cylindrical /sɪ'lɪndrɪkəl/ *adj.* 圆柱形的

nanotube /'nænəʊtjuːb/ *n.* 奈米管；纳米管

nanotechnology /'nænəʊˌtek'nɒlədʒɪ/ *n.* 纳米技术

synthesis /'sɪnθɪsɪs/ *n.*
(*plural* **syntheses**)（通过化学或生物反应进行的）合成

taxol /'tæksɒl/ *n.* 紫杉醇

condensate /kən'denseɪt/ *n.*
atmospheric moisture that has condensed because of cold 冷凝物；聚合物

quantum /'kwɒntəm/ *n.* 量子

Reading comprehension

The following table presents you an overview of the historical development of chemistry. Read Text A and complete the table to draw the outline in time sequence.

Time	Year	Scientist(s)	Achievements
16th and 17th centuries	1556		published *De re metallica* "father of metallurgy"
	1605		published "A New Light of Alchemy"
		Jean Beguin	
	1637	René Descartes	
19th century	/		proposed the atomic theory
	/	Svante Arrhenius	
	/	Michael Faraday	
early 20th century	1903		invented chromatography
			developed an early planetary model of the atom
	1905	Fritz Haber and Carl Bosch	
	/		proposed Born-Haber cycle
	1905	Albert Einstein	
	/		invented bakelite
	1909	Robert Andrews Millikan	
late 20th century	1970	John Pople	
		Yves Chauvin	
	/		discovered stereoselective oxidation reactions
	1985		discovered fullerenes
	1991	Sumio Iijima	
	1994		achieved the first total synthesis of taxol
		Eric Cornell and Carl Wieman	

Language focus

1 Study the affixes or word roots below and fill in the blanks with the example words. Change the form if necessary.

Tips

- *oxy-* / *oxi-* means "containing or using oxygen", e.g. *oxidation, oxyacid, oxyacetylene*
- *thermo-* means "using or relating to heat", e.g. *thermodynamics, thermometer, thermoplastic*
- *electro-* means "electricity or processes involving electricity", e.g. *electrolysis, electrodeposition, electronic*
- *photo-* means "related to light or photography", e.g. *photoelectric, photosynthesis, photochemistry*
- *-graphy* means "a form or process of writing, representing, etc.", e.g. *chromatography, radiography, spectrography*

1. We use a(n) _____ to check for a fever, to record data during a chemistry lab, or to help us decide how to dress before leaving for school in the morning.
2. Nonetheless, micropayments and _____ transactions have come in 2010.
3. Like humans, most animals rely on visible light for seeing, and plants rely on it for _____.
4. It is obvious that rare earths (稀土) can suppress the _____ and sulfuration of metals and alloys at high temperatures.
5. _____ is the study of the effects of work, heat and energy on a system.
6. _____ is a process used by scientists to separate complex chemical mixtures at the "nano" or molecular level by virtue of differences in absorbency.

2 Match the words or expressions in Column A with the definitions in Column B and translate them into Chinese in Column C.

Column A	Column B	Column C
___ 1. munitions	A. the scientific study of metals and how they are used	_____
___ 2. thermodynamics	B. an atom with an electrical force created by adding or removing an electron (电子)	_____
___ 3. condensate	C. a method of separating and analyzing mixtures of chemical substances by chromatographic absorption (吸附)	_____
___ 4. metallurgy	D. the science of the relationship between heat and other forms of energy	_____
___ 5. atomic theory	E. the branch of chemistry concerned with the study of electric cells and electrolysis	_____
___ 6. ion	F. military weapons and equipment	_____
___ 7. chemical equation	G. the science of making or working with things that are so small that they can only be seen using a powerful microscope	_____
___ 8. electrochemistry	H. the symbolic representation of a chemical reaction in the form of symbols and formula	_____
___ 9. chromatography	I. the assumption that matter is composed of discrete units called atoms	_____
___10. nanotechnology	J. atmospheric moisture that has condensed because of cold	_____

3 Complete the following sentences with the words or phrases below. Change the form if necessary.

apply to be intertwined with compose refine make advance
no coincidence proponent quantity time span extract

1. In analytical chemistry, _____ analysis is the determination of the absolute or relative abundance (often expressed as a concentration) of one, several or all particular substance(s) present in a sample.

2. The results of this research can be _____ new developments in technology.
3. He was an early _____ of the theory that matter is composed of particles called atoms and that these are the limit to which matter can be subdivided.
4. The advancements in society _____ the advancements in science. To understand how changes in society occurred, and will continue to change, one has to have a basic understanding of the laws of physics and chemistry.
5. Citric acid (柠檬酸) can be _____ from the juice of oranges, lemons, limes or grapefruits.
6. We guess the mistakes are due to the small sample bias and the short _____ of our data.
7. Some analysts say, the decline in crude oil prices will reduce the purchasing expenditure of Chinese oil _____ companies, by over one billion U.S. dollars.
8. With assistance from a high tech robot, National Institutes of Health researchers _____ in treating Parkinson's diseases for humans.
9. Protein molecules _____ all the complex working parts of living cells.
10. It is _____ that chemistry is referred to as an "innovation engine".

4 **Translate the following paragraph into English.**

化学的历史悠久，事实上，人类的化学活动可追溯到有历史记载以前的时期。化学家从事两种不同类型的活动：有些化学家研究并试图了解自然界，而另一些化学家则在创造自然界不存在的新物质或发现完成化学变化的新途径。自人类出现在地球上的那一刻起，就有了这两方面的活动，但上世纪其步伐大大加快了。

Critical thinking

1 **Group discussion: The changing of scientific knowledge**

Scientific knowledge is not static: It changes and evolves over time as scientists build on the ideas of others to come up with revised (and

often improved) theories and ideas. In Text A, for example, we saw how people's understanding of atomic theory changed as more information was gathered about the atom. There are many more examples in the field of science. Think about some other examples that scientific knowledge has been changed because of new ideas and discoveries:

– What were these new ideas?
– Were they controversial? If so, why?
– What role (if any) did technology play in developing these new ideas?
– How have these ideas affected the way we understand the world?

2 Read the following quotation and then work in groups to discuss the questions.

Russian chemist Dmitri Mendeleev, who developed the periodic classification of the elements, published a periodic table in 1869. In his version of the periodic table of 1871, he left gaps in places where he believed unknown elements would find their place. He even predicted the likely properties of three of the potential elements.

"As long as chemistry is studied, there will be a periodic table. And even if someday we communicate with another part of the universe, we can be sure that one thing both cultures will have common is an ordered system of the elements that will be instantly recognizable by both intelligent life forms."

John Emsley, *Nature's Building Blocks: An A-Z Guide to the Elements*

1. Discuss in groups of four or five and then share in the whole class: How can the periodic table help us quickly determine electron configurations (电子组态) and quantum numbers?
2. Tell your group members at least one example of using the periodic table to predict certain characteristics of elements.

Research task

Academic skill: Searching for information

Information can come from virtually anywhere – media, blogs, personal experiences, books, journal and magazine articles, expert opinions, encyclopedias, and web pages, etc.

1. Types of information

Type	Use
Magazine	• To find information or opinions about popular culture. • To find up-to-date information about current events. • To find non-scholarly articles about topics of interest within the subject of the magazine.
Academic journal	• To get help for your scholarly research. • To find out what has been studied on your topic. • To find bibliographies that point to other relevant research.
Database	• To find articles on specific topics. • To find online journal or news articles.
Newspaper	• To find editorials, commentaries, expert or popular opinions. • To find current local, national or world news.
Library catalog	• To find virtually any topic. • To find hard copies of current or back issue of journals, books, newspapers or magazines.
Website	• To find information from all levels of government – central to local. • To find expert or popular opinions. • To find information of various types of media, e.g. illustrations, audio and video information.

2. Searching for information

Author / Title searches

Searching by author and / or title obviously assumes that you are searching for a particular author, book or article, probably in either a database or a library catalog. Here are some tips:

- When searching by author, put the author's last name first, e.g. "Kotler, Philip", not "Philip Kotler", if he is from an English-speaking country. Search the author's full name in Chinese order if he is a Chinese. Sometimes, the

author could be an organization, so give the full name of the organization as it commonly appears, e.g. "World Bank".

- When searching by title, it helps if you enter the title as correctly as possible.

Keyword searches

It is basically a way of searching through subject or topic. Most library catalogs and databases will include an option to search by keyword as an alternative to author and title. The first step of keyword search is to decide the key word(s) or phrase(s). Normally, the word(s) or phrase(s) which can cover the topic you search can be selected as keyword(s). A good research topic usually contains two or three concepts. For example, you need to write a paper on "The Impact of Cognitive Styles on Design Students' Spatial Knowledge". We can break the topic into concepts, like "cognitive styles" and "spatial knowledge", which can be used as keywords. Then type them in a search bar in a database, EBSCOhost for instance. In a database, there are usually two ways of search, i.e., basic search and advanced search.

Basic search (see Fig. 1) generates a large number of sources for you to differentiate, which is an exhausting task. But advanced search (see Fig. 2), which provides more choices for further conditioning, can make the work lighter. There are many variables that can be chosen to refine the search. And you can define the relationship between the keywords by choosing "and", "or" or "not" based on the results you intend to obtain.

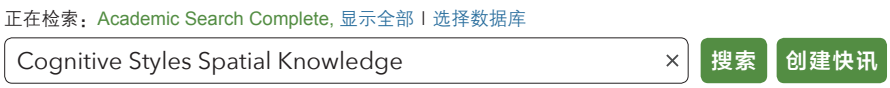


Fig. 1 Basic search

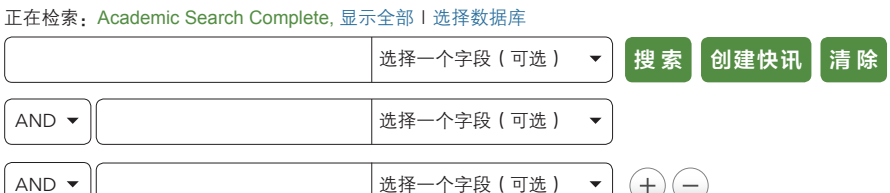


Fig. 2 Advanced search

As "cognitive styles" is a broader topic and "spatial knowledge" is more specific, they can be typed in the upper and middle search bars respectively. More relevant results will appear. You can then refine the search by selecting a specific variable. In this case, "subject" (主题语) can be chosen to filter the results (See Fig. 3).

Fig. 3

Snowball search

It is a good way if your topic has a key work or author. You can trace the citations of that author using a specialized citation database, such as the Social Science Citation Index to obtain other key works or authors. You will follow the stream of research up to the near present and see the way in which the work or the author has influenced the subsequent studies.

3. Evaluating information

Once you have found information that satisfies the requirements of your research, you should evaluate it. Evaluating information encourages you to think critically about the reliability, validity, accuracy, authority, timeliness, point of view or bias of information.

When evaluating information, you can use the five criteria AAOCC, namely, Authority, Accuracy, Objectivity, Currency and Coverage. They can be applied to check all information.

1) Authority of information

- Who published it?
- What institution published it?
- Does the publisher list his or her qualifications?

2) Accuracy of information
   - Who provided it, and can you contact him or her?
   - Does it provide enough details?
   - Has it been cited correctly?
3) Objectivity of information
   - What is the purpose of it, or why was it published?
   - Is it biased?
   - What opinions (if any) are expressed by the author?
4) Currency of information
   - When was it published?
   - When was it updated?
   - How up-to-date is it?
5) Coverage of information
   - Do citations in it complement the research?
   - Is it all text or a balance of text and image?
   - Is it free or is there a fee to obtain it?

Task

In Text A, we read the following two sentences:

- In 1605, Sir Francis Bacon published *The Proficience and Advancement of Learning*, which contains a description of what would later be known as the scientific method.
- In 1637 René Descartes publishes *Discours de la méthode*, which contains an outline of the scientific method.

As we know, *The Proficience and Advancement of Learning* by Bacon and *Discours de la méthode* by Descartes are not only influential works in the history of modern philosophy, but also very important to the development of natural sciences. Now try to find more information about their discourses on **scientific method** and make an oral report to the class using the sources mentioned above.

Section B

Reading strategy

Dealing with unknown words (Part I)

The ability to deal with unknown words is a key reading skill in the reading process. It is a vital skill because you are almost certain to find unknown or unfamiliar words in any text. The skill is not necessarily to "know" the words, but to guess the meaning of them so that you can read and understand the whole text. Here are several different ways that can help you guess the meaning of an unknown word.

Guessing by explanation

Sometimes, you will find that the meaning of an unfamiliar word is given to you in the text. Typically, the phrase or sentence immediately before or after the unfamiliar word may give you a hint about the word. In this case, what you need to do is keep on reading and do not stop at the moment you find the unfamiliar word, and then guess the meaning from the context. For example:

In 1906, Mikhail Tsvet invented chromatography, an important analytic technique.

When you read the word "chromatography", you may stop because you are not familiar with it; but keep on reading and soon you will find this term is explained in the part after the comma "an important analytic technique".

Guessing by synonyms and antonyms

This is a very useful skill to learn. What you should do here is look at other words which relate to that word and work out what it may mean. These words may be either synonyms (words with a similar meaning) or antonyms (words with an opposite meaning). For example:

Haber has also been described as the "father of chemical warfare" for his work developing and deploying chlorine and other poisonous gases during World War I.

Here you should understand that "chlorine" is similar to the part after it — "other poisonous gases". Even though you do not know exactly what gas chlorine is, this does not interfere with your understanding of the text. So guessing instead of consulting is the best way to understand the sentence during your reading process.

Sometimes, when you come across an unknown word, you can also ignore the meaning besides guessing it. If the word starts with a capital letter, it is in all probability a proper name. In this case, you should waste no time in trying to understand what the word means. Likewise, if the word is in italics, it is also almost certainly a scientific / technical term that you do not need to know the exact meaning. For example:

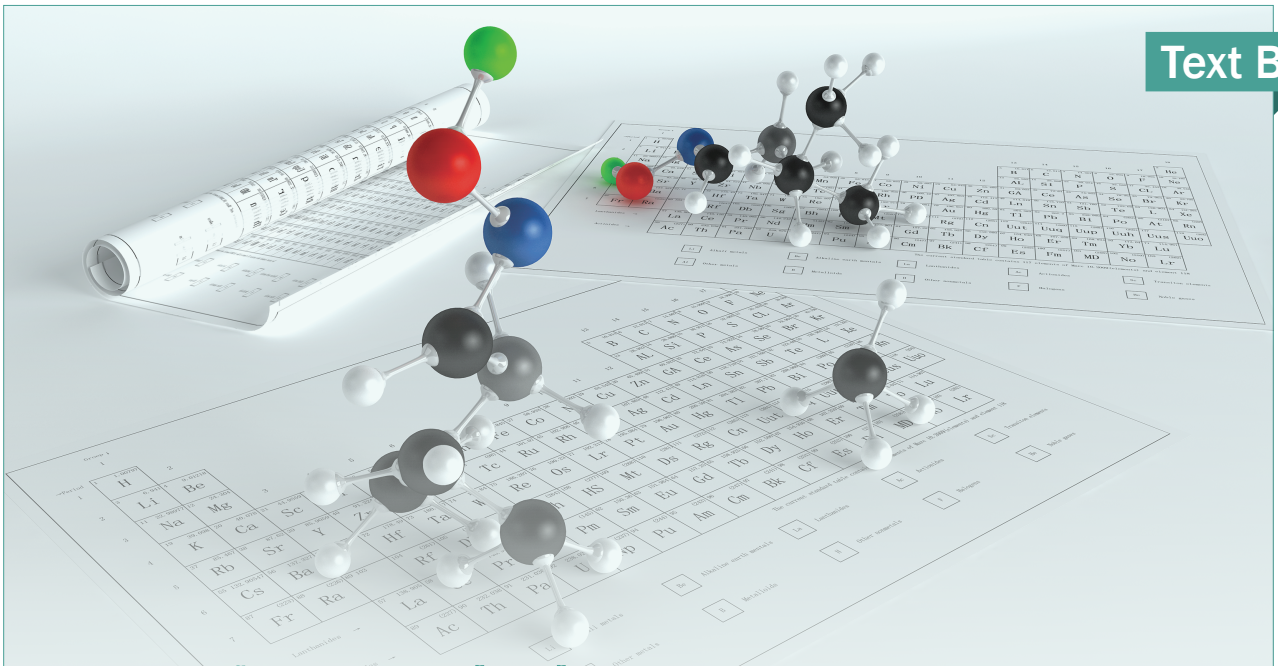
In 1905, Albert Einstein explained Brownian motion in a way that definitively proved atomic theory.

"Brownian" is a word that you should learn to ignore because it is in capital and therefore it might refer to the name of a kind of "motion", and it is totally OK if you do not know the meaning or origin of it.

Task

Read Text B and apply the skills above to deal with the underlined words.

Text B



Chemical element

1 A chemical element is a chemical substance consisting of atoms having the same number of protons in their atomic nuclei (i.e. the same atomic number, Z). There are 118 elements that have been identified, of which the first 94 occur naturally on the Earth with the remaining 24 being synthetic elements. There are 80 elements that have at least one stable isotope and 38 that have exclusively radioactive isotopes, which decay over time into other elements. Iron is the most abundant element (by mass) making up the Earth, while oxygen is the most common element in the crust of the Earth.

proton *n.* 质子
atomic nuclei 原子核
isotope *n.* 同位素
crust *n.* 地壳

2 Chemical elements constitute approximately 15% of the matter in the universe: The remainder is dark matter, the composition of which is unknown, but it is not composed of chemical elements. The two lightest elements, hydrogen and helium, were mostly formed in the Big Bang and are the most common elements in the universe. The next three elements (lithium, beryllium and boron) were formed mostly by cosmic ray spallation, and are thus rarer than those that follow. Formation of elements with from 6 to 26 protons occurred and continues to occur in main sequence stars via stellar nucleosynthesis. The high abundance of oxygen, silicon, and iron on the Earth reflects their common production in such stars. Elements with greater than 26 protons are formed by supernova nucleosynthesis in supernovae, which, when they explode, blast these elements far into space as planetary nebulae, where they may become incorporated into planets when they are formed.

3 When different elements are chemically combined, with the atoms held together by chemical bonds, they form chemical compounds. Only a minority of elements are found uncombined as relatively pure minerals. Among the more common of such "native elements" are copper, silver, gold, carbon (as coal, graphite, or diamonds), and sulfur. All but a few of the most inert elements, such as noble gases and noble metals, are usually found on the Earth in chemically combined form, as chemical compounds. While about 32 of the chemical elements occur on the Earth in native uncombined forms, most of these occur as mixtures. For example, atmospheric air is primarily a mixture of nitrogen, oxygen, and argon, and native solid elements occur in alloys, such as that of iron and nickel.

4 The history of the discovery and use of the elements began with primitive human societies that found native elements like carbon, sulfur, copper and gold.

Big Bang 宇宙大爆炸
helium *n.* 氦
lithium *n.* 锂
beryllium *n.* 铍
boron *n.* 硼
stellar nucleosynthesis 恒星核合成
supernova nucleosynthesis 超新星核合成
planetary nebulae 行星状星云
graphite *n.* 石墨
argon *n.* 氩

Later civilizations extracted elemental copper, tin, lead and iron from their ores by smelting, using charcoal. Alchemists and chemists subsequently identified many more, with almost all of the naturally-occurring elements becoming known in the 1900s.

5 The properties of the chemical elements are summarized on the periodic table, which organizes the elements by increasing atomic number into rows ("periods") in which the columns ("groups") share recurring ("periodic") physical and chemical properties. Save for unstable radioactive elements with short half-lives, all of the elements are available industrially, most of them in high degrees of purity.

Description

6 The lightest chemical elements, hydrogen and helium, both are thought to be created by Big Bang nucleosynthesis during the first few minutes of the universe in a ratio of around 3:1 by mass (or 12:1 by number of atoms), along with tiny traces of the next two elements, lithium and beryllium. Almost all other elements found in nature were made by various natural methods of nucleosynthesis. On the Earth, small amounts of new atoms are naturally produced in nucleogenic reactions, or in cosmogenic processes, such as cosmic ray spallation. New atoms are also naturally produced on the Earth as radiogenic daughter isotopes of ongoing radioactive decay processes such as alpha decay, beta decay, spontaneous fission, cluster decay, and other rarer modes of decay.

7 Of the 94 naturally-occurring elements, those with atomic numbers 1 through 82 each have at least one stable isotope, (except for technetium, element 43 and promethium, element 61, which have no stable isotopes). Isotopes considered stable are those for which no radioactive decay has yet been observed. Elements with atomic numbers 83 through 94 are unstable to the point that radioactive decay of all isotopes can be detected. Some of these elements, notably bismuth

nucleogenic *adj.* 核能基因的
cosmogenic *adj.* 宇宙发生的
bismuth *n.* 铋

(atomic number 83), thorium (atomic number 90), uranium (atomic number 92) and plutonium (atomic number 94), have one or more isotopes with half-lives long enough to survive as remnants of the explosive stellar nucleosynthesis that produced the heavy elements before the formation of our solar system. For example, at over 1.9×1019 years, over a billion times longer than the current estimated age of the universe, bismuth-209 (atomic number 83) has the longest known alpha decay half-life of any naturally-occurring element. The heavy elements (those beyond plutonium, element 94) undergo radioactive decay with half-lives so short that they do not occur in nature and must be synthesized.

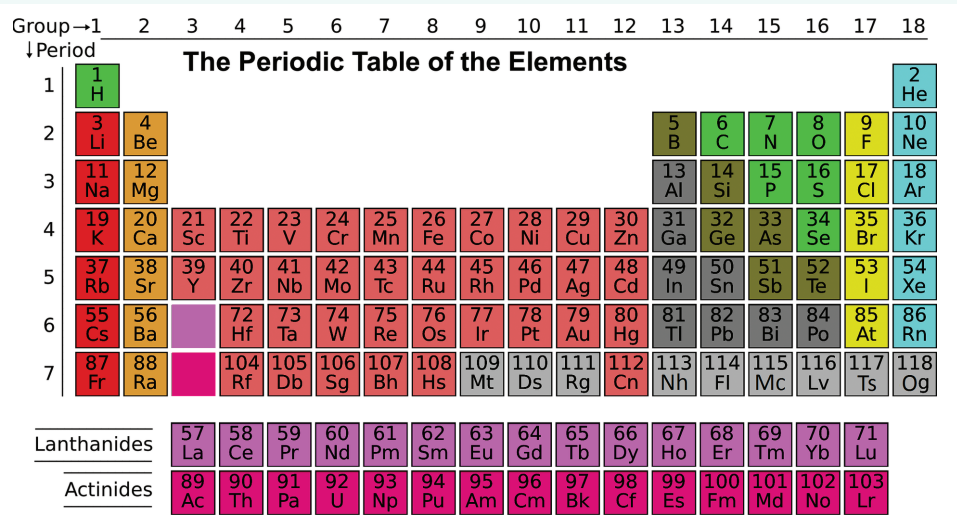
8 As of 2010, there are 118 known elements (in this context, "known" means observed well enough, even from just a few decay products, to have been differentiated from other elements). Of these 118 elements, 94 occur naturally on the Earth. Six of these occur in extreme trace quantities: technetium, number 43; promethium, number 61; astatine, number 85; francium, number 87; neptunium, number 93; and plutonium , number 94. The 94 elements have been detected in the universe at large, in the spectra of stars and also supernovae, where short-lived radioactive elements are newly being made. The first 94 elements have been detected directly on the Earth as primordial nuclides present from the formation of the solar system, or as naturally-occurring fission or transmutation products of uranium and thorium.

9 The remaining 24 heavier elements, not found today either on the Earth or in astronomical spectra, have been produced artificially: They are all radioactive, with very short half-lives; if any atoms of these elements were present at the formation of the Earth, they are extremely likely, to the point of certainty, to have already decayed, and if present in novae, they have been in quantities too small to have been noted. Technetium was the first purportedly non-naturally occurring element synthesized, in 1937, although trace amounts of technetium

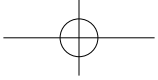
thorium *n.* 钍
uranium *n.* 铀
plutonium *n.* 钚
technetium *n.* 锝
promethium *n.* 钷
astatine *n.* 砹
francium *n.* 钫
neptunium *n.* 镎
fission *n.* 裂变
transmutation *n.* 演变

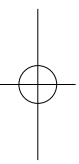
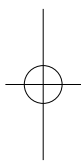
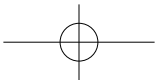
have since been found in nature (and also the element may have been discovered naturally in 1925). This pattern of artificial production and later natural discovery has been repeated with several other radioactive naturally-occurring rare elements.

10 Lists of the elements are available by name, symbol, atomic number, density, melting point, and boiling point as well as ionization energies. The nuclides of stable and radioactive elements are also available as a list of nuclides, sorted by length of half-life for those that are unstable. One of the most convenient, and certainly the most traditional presentation of the elements, is in the form of the periodic table, which groups together elements with similar chemical properties (and usually also similar electronic structures).



ionization energy 电离能

Unit 1

Introduction to civil engineering

In this unit, you will learn:

- **Subject-related knowledge:** The mission of civil engineering
  Engineering wonders of the modern world
- **Academic skill:** Searching for information
- **Reading strategy:** Dealing with unknown words (Part I)

Section A

Pre-reading

Civil engineering helps people shape the world. Discuss the following questions in groups.

1. Can you name any civil engineering wonders, ancient or modern?
2. Can you name any of the most famous civil engineers the world has ever known?
3. How much do you know about the branches of civil engineering?

1 Civil engineering is arguably the oldest and broadest engineering discipline among all the engineering fields. It deals with the planning, designing, constructing and maintaining of buildings and various other structures. From huge dams to sky-high buildings, from suspension bridges to offshore drilling platforms, many physical concrete structures come under civil engineering.

Civil engineering then and now

2 The history of civil engineering can be traced back to ancient times when the sole means of construction was human labor, lacking any sophisticated equipment. Ancient civil engineering projects include the Roman public baths, the Mayan ruins at Copan, Palenque and Tikal, and the cliff dwellings at Mesa Verde.

What is civil engineering?

Text A

3 Many early civilizations built monuments to their rulers or gods. These may have been simple mounds or truly remarkable achievements, such as the Pyramids of Giza whose construction by pre-industrial societies remains mysterious. The names of the engineers who designed these wonders are lost in antiquity.

4 Nowadays, we often associate civil engineering with the world's most jaw-dropping structures. These include the Brooklyn Bridge, Hoover Dam, the Panama Canal, the Golden Gate Bridge, and the Eiffel Tower.

5 But civil engineering isn't all about designing fancy buildings – it's also about maintaining and adapting the infrastructure that we depend on every day, such as roads, railways and bridges, energy and water supply, waste networks and flood defenses. Civil engineers have to keep this infrastructure running effectively and adapt it to meet challenges, such as population growth, climate change and natural disasters. They literally shape the world we live in.

Branches of civil engineering

6 Civil engineering is arguably the most diverse field of all the engineering branches. As the population of the world increases and the technology becomes more advanced, the need for better infrastructure increases around the world. In order to manage the construction process in each sector, the field of civil engineering has been divided into various sub-disciplines on the basis of applications. Some of the main branches are introduced below.

7 **Structural engineering:** It is the field of engineering particularly concerned with the design of load-bearing structures. The load acting on a structure is ultimately transferred to ground. In doing so, various components of the structure are subjected to internal stresses. For example, in a building, the load acting on a slab is transferred by the slab to ground through beams, columns and footings. Structural engineers identify the loads that act on the structures as well as stresses that are created by the loads, and then design structures that can withstand the loads. Structures should remain stable and secure throughout their use and at the same time, be economical and fulfill the desired functions.

8 **Geotechnical engineering:** Geotechnical engineering is the branch of engineering dealing with the analysis, design and construction of foundations, slopes, retaining structures and other systems that are made of or are supported by soil or rock. Technical information obtained from the sciences of geology, material testing, and hydraulics is applied in the design of foundations and structures to ensure safety and economy of construction.

9 **Water resources engineering:** This discipline involves the design and operation of systems to control and utilize water, the design of urban storm-sewer systems, dams and breakwaters, the management of water supplies and waterways, erosion and flood protection. The fields of hydrology, geology, and environmental science are included in this discipline of civil engineering.

10 **Transportation engineering:** It provides for the safe, efficient and convenient movement of people, goods and services by planning, constructing, and maintaining road, rail, air and public transit systems. The transportation

infrastructure should ensure mobility and accessibility for all segments of society while promoting socially desirable land use.

11 **Environmental engineering:** Environmental engineering aims to improve the environment and deals with constructing structures that have a low impact on the environment. Some of its applications include purifying the contaminated air and water, managing the waste, and protecting the marine environment.

12 **Other disciplines:** Some of the other disciplines included in civil engineering are coastal engineering, construction engineering, earthquake engineering, materials science, and surveying.

The role of civil engineers

13 Civil engineers can be involved in nearly every stage of a construction project, which includes site selection, writing specifications for processes and materials, reviewing bids from subcontractors, ensuring compliance with building codes, supervising all phases of construction from grading and earthmoving to painting and finishing, as well as the maintenance of the finished projects.

14 All civil engineers are required to be innovative and logical individuals. Other essential attributes civil engineers need include: creativity, versatility, a problem-solving mind, and the ability to understand the bigger picture and to collaborate with a number of other professionals.

The future of civil engineering

15 From the ancient simple mounds to the skyscrapers today, the world has witnessed immense advancement in the field of civil engineering. The future of civil engineering is expected to be further revolutionized by the new technologies including design software, GPS, GIS and other latest technical expertise in varied fields.

New words and expressions

sophisticated /sə'fɪstɪkeɪtɪd/ *adj.*
complicated and refined 精良的

mound /maʊnd/ *n.*
a structure consisting of an artificial heap usually of earth or stones 土 (石) 堆

antiquity /æn'tɪkwətɪ/ *n.*
the state of being very old 年代久远

jaw-dropping /'dʒɔːˌdrɒpɪŋ/ *adj.*
extremely surprising 极度令人惊讶的

load-bearing /'ləʊd'beərɪŋ/ *adj.* 承重的

slab /slæb/ *n.*
a thick flat piece of a hard material 厚板

beam /biːm/ *n.*
a long heavy piece of wood or metal used in building houses, bridges, etc. 梁

column /'kɒləm/ *n.*
a tall solid upright stone post used to support a building or as a decoration 柱

footing /'fʊtɪŋ/ *n.*
(usually plural) the solid base of bricks, stone, etc. that is under a building to support it and fasten it to the ground (一般用复数) 地基；底脚

geotechnical /ˌdʒiːəʊ'teknɪkəl/ *adj.* 土地工程学的

geology /dʒɪ'ɒlədʒɪ/ *n.*
a science that deals with rock, soil, etc. and the way they have changed since the Earth was formed 地质学

hydraulics /haɪ'drɔːlɪks/ *n.* 水力学

breakwater /'breɪkˌwɔːtə(r)/ *n.* 防波堤

waterway /'wɔːtəweɪ/ *n.*
a river or canal that boats travel on 水路；航道

hydrology /haɪ'drɒlədʒɪ/ *n.* 水文学

transit /'trænsɪt/ *n.*
the process of moving passengers or goods 运输

accessibility /əkˌsesə'bɪlətɪ/ *n.*
the quality of being at hand when needed 可达性

segment /'segmənt/ *n.*
one of several parts or pieces that fit with others to constitute a whole object 部分

specification /ˌspesɪfɪ'keɪfən/ *n.*
(usually plural) a detailed description of how something should be made (一般用复数) 规格说明；明细规范

bid /bɪd/ *n.*
an offer to do work or provide services for a specific price 投标

compliance /kəm'plaɪəns/ *n.*
action in accordance with certain accepted standards 遵守

grading /'greɪdɪŋ/ *n.* 级配

attribute /ə'trɪbjuːt/ *n.*
a quality regarded as a natural or typical part of sb. / sth. 特质

versatility /ˌvɜːsə'tɪlətɪ/ *n.*
the state of having a wide variety of skills 多才多艺

expertise /ˌekspɜː'tiːz/ *n.*
special skills or knowledge that you get from experience, training, or study 专门知识或技能

suspension bridge 悬索桥
flood defense 防洪设施
storm sewer 雨水道
building code 建筑规范
GIS (Geographic Information System) 地理信息系统

Reading comprehension

Fill in the blanks based on the information from Text A.

Civil engineering has a long history, and can be 1) _____ back to the ancient times when human beings lacked the 2) _____ equipment for construction. Civil engineering is not only about designing and constructing, but also about 3) _____ and 4) _____ the infrastructure. As a 5) _____ field of the engineering branches, civil engineering can be divided into various sub-disciplines: 6) _____ engineering is a civil engineering branch focusing on the framework of structures. 7) _____ engineering is a branch of civil engineering concerned with the engineering behavior of earth materials. And water resources engineering deals with the design and operation of systems to control and 8) _____ water. Civil engineers 9) _____ all phases of construction and the 10) _____ of the finished projects.

Language focus

1 **Match the English words with their Chinese equivalents in Column B and C. Compare the general and specialized meanings of the words, and then choose the appropriate words to complete the following sentences. Change the form if necessary.**

Column A	Column B	Column C
___ 1. process	A. 出价	a. 级配
___ 2. discipline	B. 专栏	b. 地基
___ 3. column	C. 过程	c. 投标
___ 4. beam	D. 光线	d. 荷载
___ 5. foundation	E. 基础	e. 工序
___ 6. bid	F. 纪律	f. 学科
___ 7. grading	G. 负担	g. 支柱
___ 8. load	H. 分级	h. 横梁

1. Without a construction _____ proposal, there would be no way to establish the overall cost of a project, which would throw the project and the contractor-client relationship into chaos.
2. The effort spent on careful _____, mixing and compaction of concrete will be largely wasted if the concrete is badly cured (养护).
3. Every construction _____ is unique and depends on the scope and complexity of the project.
4. Engineers in the _____ of water resources engineering are concerned with sustainable water resources management, systems of water supply and distribution, water quality, etc.
5. A _____ or pillar in architecture and structural engineering is a structural element that transmits, through compression, the weight of the structure above to other structural elements below.
6. There are different types of _____ for building construction and their uses depend on soil condition and loads from the structure.
7. The primary function of a bridge is to carry traffic _____: heavy trucks, cars, and trains.
8. The condition of this major supporting _____ put the top four floors of the building at risk.

2 Study the meaning of the underlined words in the following sentences and choose their synonyms from the words in brackets.

1. The history of civil engineering can be traced back to ancient times when the sole means of construction was human labor, lacking any sophisticated (prominent, advanced, significant, elegant) equipment.
2. Ancient civil engineering projects include the Roman public baths, the Mayan ruins (exhaust, remains, surplus, allowances) at Copan, Palenque and Tikal, and the cliff dwellings at Mesa Verde.
3. The names of the engineers who designed these wonders are lost in antiquity (exhibition, transportation, ancientness, exploration).
4. Nowadays, we often associate civil engineering with the world's most jaw-dropping (surprising, elegant, luxurious, glorious) structures.
5. Civil engineering is arguably the most diverse (prosperous, distinctive, diplomatic, varied) field of all the engineering branches.

6. The transportation infrastructure should ensure mobility and accessibility for all segments (parts, proportions, criteria, phases) of society while promoting socially desirable land use.
7. Other essential attributes (qualities, contributions, inspirations, talents) civil engineers need include: creativity, versatility, a problem-solving mind, and the ability to understand the bigger picture and to collaborate with a number of other professionals.
8. Environmental engineering is related to the science of waste management of all types: purification of water, cleaning of contaminated (congested, contagious, polluted, epidemic) areas, and reduction of pollution.

3 **Match the English expressions in the field of civil engineering listed in Column A with their definitions in Column B, and then translate the expressions into Chinese in Column C.**

Column A	Column B	Column C
___ 1. building code	A. a structure that bears a load resting upon it by transferring its weight to a foundation structure	_____
___ 2. earth moving	B. a professional discipline dealing with the designing, planning, constructing, and managing of facilities and infrastructures	_____
___ 3. construction project	C. a set of rules that specify the standards for constructing objects such as buildings and non-building structures	_____
___ 4. load-bearing structure	D. the process of excavating, transporting, or pushing earth	_____
___ 5. construction engineering	E. a bridge that has no supports under it, but is hung from strong steel ropes fixed to towers	_____
___ 6. suspension bridge	F. the project of constructing a building or infrastructure	_____

4 Translate the following paragraph into English.

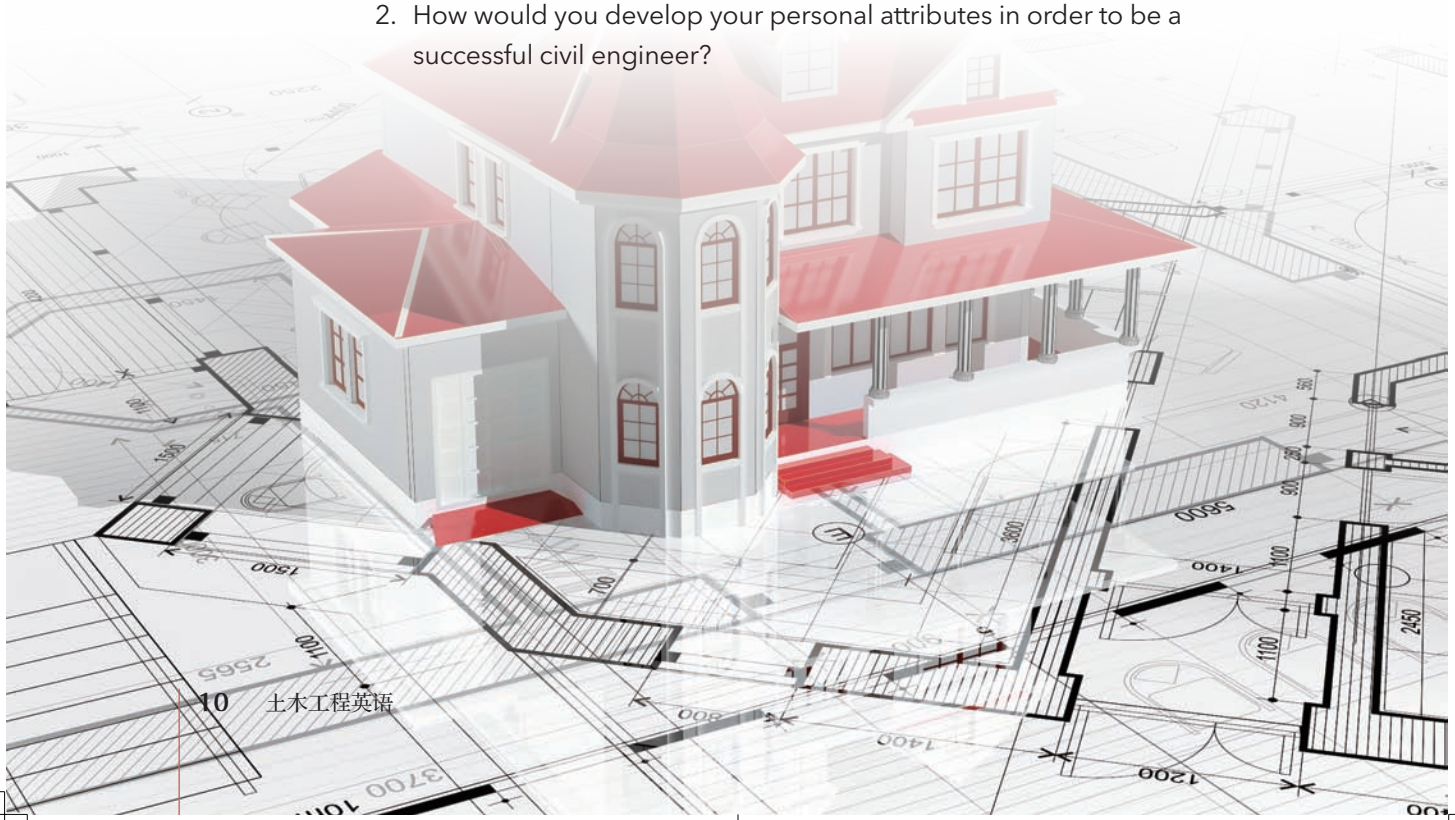
土木工程是工程学的一个分支，主要研究建筑物的设计和建造。根据工程的类型，土木工程被细分（subdivide）为许多技术专业。它们是结构工程、水资源工程、岩土工程、环境工程、运输工程等。每个专业都有特殊的用途。但是为了完成一项工程，必须把它们协调在一起。土木工程学科特别具有挑战性，这是由于工程师设计和建造的每一幢建筑物或每一个系统几乎都是独一无二的，一种结构几乎不可能与另一种结构完全相同。

Critical thinking

As is mentioned in Text A, civil engineers play different roles and shoulder many duties from the inception of a project right to its completion. Civil engineers are required to be knowledgeable, logical, creative and versatile. And they also need to have a problem-solving mind, and the ability to understand a big picture and to collaborate with a number of other professionals.

Discuss the following questions in groups:

1. Why do you think civil engineers should possess the above-mentioned attributes?
2. How would you develop your personal attributes in order to be a successful civil engineer?



Research task

Academic skill: Searching for information

Information can come from virtually anywhere – media, blogs, personal experiences, books, journal and magazine articles, expert opinions, encyclopedias, and web pages, etc.

1. Types of information

Type	Use
Magazine	• To find information or opinions about popular culture. • To find up-to-date information about current events. • To find non-scholarly articles about topics of interest within the subject of the magazine.
Academic journal	• To get help for your scholarly research. • To find out what has been studied on your topic. • To find bibliographies that point to other relevant research.
Database	• To find articles on specific topics. • To find online journals or news articles.
Newspaper	• To find editorials, commentaries, expert or popular opinions. • To find current local, national or world news.
Library catalog	• To find virtually any topic. • To find hard copies of current or back issue of journals, books, newspapers or magazines.
Website	• To find information from all levels of government – central to local. • To find expert or popular opinions. • To find information of various types of media, e.g. illustrations, audio and video information.

2. Searching for information

Author / Title search

Searching by author and / or title obviously assumes that you are searching for a particular author, book or article, probably in either a database or a library catalog. Here are some tips:

- When searching by author, put the author's last name first, e.g. "Kotler, Philip", not "Philip Kotler", if he is from an English-speaking country. Search the author's full name in Chinese order if he is a Chinese. Sometimes, the

author could be an organization, so give the full name of the organization as it commonly appears, e.g. "World Bank".

- When searching by title, it helps if you enter the title as precisely as possible.

Keyword search

It is basically a way of searching through subject or topic. Most library catalogs and databases will include an option to search by keyword as an alternative to author and title. The first step of keyword search is to decide the key word(s) or phrase(s). Normally, the word(s) or phrase(s) which can cover the topic you search can be selected as keyword(s). A good research topic usually contains two or three concepts. For example, you need to write a paper on "The Impact of Cognitive Styles on Design Students' Spatial Knowledge". We can break the topic into concepts, like "cognitive styles" and "spatial knowledge", which can be used as keywords. Then type them in a search bar in a database, EBSCOhost for instance. In a database, there are usually two ways of search, i.e. basic search and advanced search.

Basic search (see Fig. 1) generates a large number of sources for you to differentiate, which is an exhausting task. But advanced search (see Fig. 2), which provides more choices for further conditioning, can make the work lighter. There are many variables that can be chosen to refine the search. And you can define the relationship between the keywords by choosing "and", "or" or "not" based on the results you intend to obtain.

Fig. 1 Basic search

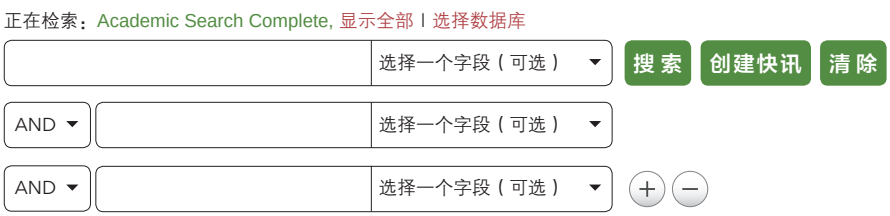


Fig. 2 Advanced search

As "cognitive styles" is a broader topic and "spatial knowledge" is more specific, they can be typed in the upper and middle search bars respectively. More relevant results will appear. You can then refine the search by selecting a specific variable. In

this case, "subject" (主题语) can be chosen to filter the results (See Fig. 3).

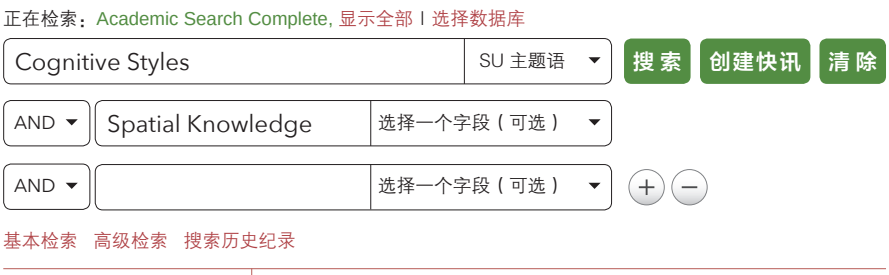


Fig. 3

Snowball search

It is a good way if your topic has a key work or author. You can trace the citations of that author using a specialized citation database, such as the Social Science Citation Index to obtain other key works or authors. You will follow the stream of research up to the near present and see the way in which the work or the author has influenced the subsequent studies.

3. Evaluating information

Once you have found information that satisfies the requirements of your research, you should evaluate it. Evaluating information encourages you to think critically about the reliability, validity, accuracy, authority, timeliness, point of view or bias of information.

When evaluating information, you can use the five criteria AAOCC, namely, Authority, Accuracy, Objectivity, Currency and Coverage. They can be applied to check all information.

1) Authority of information
   - Who published it?
   - What institution published it?
   - Does the publisher list his or her qualifications?
2) Accuracy of information
   - Who provided it, and can you contact him or her?
   - Does it provide enough details?
   - Has it been cited correctly?

3) Objectivity of information
   - What is the purpose of it, or why was it published?
   - Is it biased?
   - What opinions (if any) are expressed by the author?
4) Currency of information
   - When was it published?
   - When was it updated?
   - How up-to-date is it?
5) Coverage of information
   - Do citations in it complement the research?
   - Is it all text or a balance of text and image?
   - Is it free or is there a fee to obtain it?

Task

Now you know what civil engineering is and what a civil engineer does. Work in groups and search some information on a famous civil engineering structure or a well-known architect. Evaluate the information using the AAOCC criteria. Then complete the following table and share the information in groups.

	Where you searched	How you searched	What you've found
1			
2			
3			
…			

Section B

Reading strategy

Dealing with unknown words (Part I)

The ability to deal with unknown words is a key reading skill in the reading process. It is a vital skill because you are almost certain to find unknown or unfamiliar words in any text. The skill is not necessarily to "know" the words, but to guess the meaning of them so that you can read and understand the whole text. Here are several different ways that can help you guess the meaning of an unknown word.

Guessing by explanation

Sometimes, you will find that the meaning of an unfamiliar word is given to you in the text. Typically, the phrase or sentence immediately before or after the unfamiliar word may give you a hint about the word. In this case, what you need to do is keep on reading and do not stop at the moment when you find the unfamiliar word, and then guess the meaning from the context. For example:

> ***Transportation engineering:*** *It provides for the safe, efficient and convenient movement of people, goods and services by planning, constructing, and maintaining road, rail, air and public transit systems. The transportation infrastructure should ensure mobility and accessibility for all segments of society while promoting socially desirable land use.*

"Transit" may be unfamiliar to you. However, if you read the rest of the paragraph, "It provides for the ... movement of people, goods and services by planning, constructing, and maintaining road, rail, air ... systems. The transportation infrastructure should ensure mobility and accessibility for all segments of society ...", it is obvious that "transit" should mean "the process of moving goods or people from one place to another".

Guessing by synonym and antonym

This is a very useful skill to learn. What you should do here is look at other words which relate to that word and work out what it may mean. These words may be either synonyms (words with a similar meaning) or antonyms (words with an opposite meaning). For example:

> *From the ancient simple mounds to the skyscrapers today, the world has witnessed immense advancement in the field of civil engineering.*

Here you can work out the meaning of "mounds" by its antonym "skyscrapers". All you need to do is read the rest part of the sentence and think of the meaning of it.

Sometimes, when you come across an unknown word, besides guessing it, you can also ignore the word, especially when the word starts with a capital letter or is in italics, which means that it is in all probability a proper name or a loanword. In this case, you should waste no time in trying to understand the exact meaning of the word. For example:

> *Many early civilizations built monuments to their rulers or gods. These may have been simple mounds or truly remarkable achievements, such as the Pyramids of*

Giza whose construction by pre-industrial societies remains mysterious.

Here the word "Giza" is a word that you should learn to ignore because it starts with a capital letter and is therefore a word which may not influence the overall meaning of the sentence.

Task

Read Text B and apply the skills above to guess the meaning of the underlined words.

Text B

Civil engineering wonders

1 Civil engineering projects frequently dominate headlines across the world. From the world's tallest building to the biggest man-made islands, people everywhere are dependent upon civil engineering innovations. All of these innovations and constructions tie back to one main purpose – making life easier for humankind. Here are some civil engineering marvels, which can make anyone gasp in awe.

Akashi Kaikyo Bridge

2 Also known as the Pearl Bridge, it is a stunning sample of the modern civil engineering. Located in Japan, this bridge is the world's largest suspension bridge and there are no pillars for the supports. It has the longest central span of any suspension bridge in the world, at 1,991 meters. It was completed in 1998. The bridge links the city of Kobe on the mainland of Honshu to Iwaya on Awaji Island by crossing the busy Akashi Strait. It carries part of the Honshu-Shikoku Highway.

Delaware Aqueduct

3 New York City is a hub for tourism, business, and the arts, and it also is home to roughly 8.5 million people. Like all heavily populated areas, the issue of fresh water supply comes into question. The Delaware Aqueduct, while possibly one of the least identifiable projects on this list, is not lacking in its civil engineering wonder. Spanning a total of 170 km, this major aqueduct holds the title of longest continuous tunnel in the world. Almost 50,000,000 cubic meters of water is supplied through this tunnel each day to the U.S.'s largest city. This accounts for over half of the total water supply of the city, making this project vital to the lives of millions of American citizens.

Mubarak Pumping Station

4 Like many other countries, Egypt has experienced exponential growth in recent years. Much of the country of Egypt is arid desert, and in an effort to expand usable land, engineers built a pumping station aimed at making up to 25% of Egypt's land habitable. Before this project, only 5% of the country's land was considered to be able to sustain human development and life. The Mubarak Pumping Station is part of a civil engineering plan called the Toshka Project. The station hub is designed much like an island with the structure positioned in the center of Lake Nasser. Twenty-four vertical pumps help channel the water to the surrounding desert areas from this central location.

Nord Stream Gas Pipeline

5 Nord Stream Gas Pipeline is an offshore natural gas pipeline from Vyborg in Russia to Lubmin near Greifswald in Germany. With 1,224 kilometers in length, it is the longest subsea pipeline in the world, surpassing the Langeled pipeline. This project includes two parallel lines. The first line of the pipeline was laid by June 2011 and was inaugurated on 8 November 2011. The second line was laid in April 2012 and was inaugurated on 8 October 2012.

Beijing National Stadium

6 As the world's largest-span steel structure, Beijing National Stadium is also known as the Bird's Nest. This astonishing structure looks more like a public work of art than an Olympic stadium. It is a joint venture among architects Jacques Herzog and Pierre de Meuron, project architect Stefan Marbach, artist Ai Weiwei, and China Architecture Design & Research Group which was led by Chief Architect Li Xinggang. The Stadium was for use throughout the 2008 Summer Olympics and Paralympics.

Venice Tide Barrier Project

7 As one of the most picturesque cities in the world, Venice, Italy is shrouded in beauty, but the city faces major engineering problems. The city has been pummeled

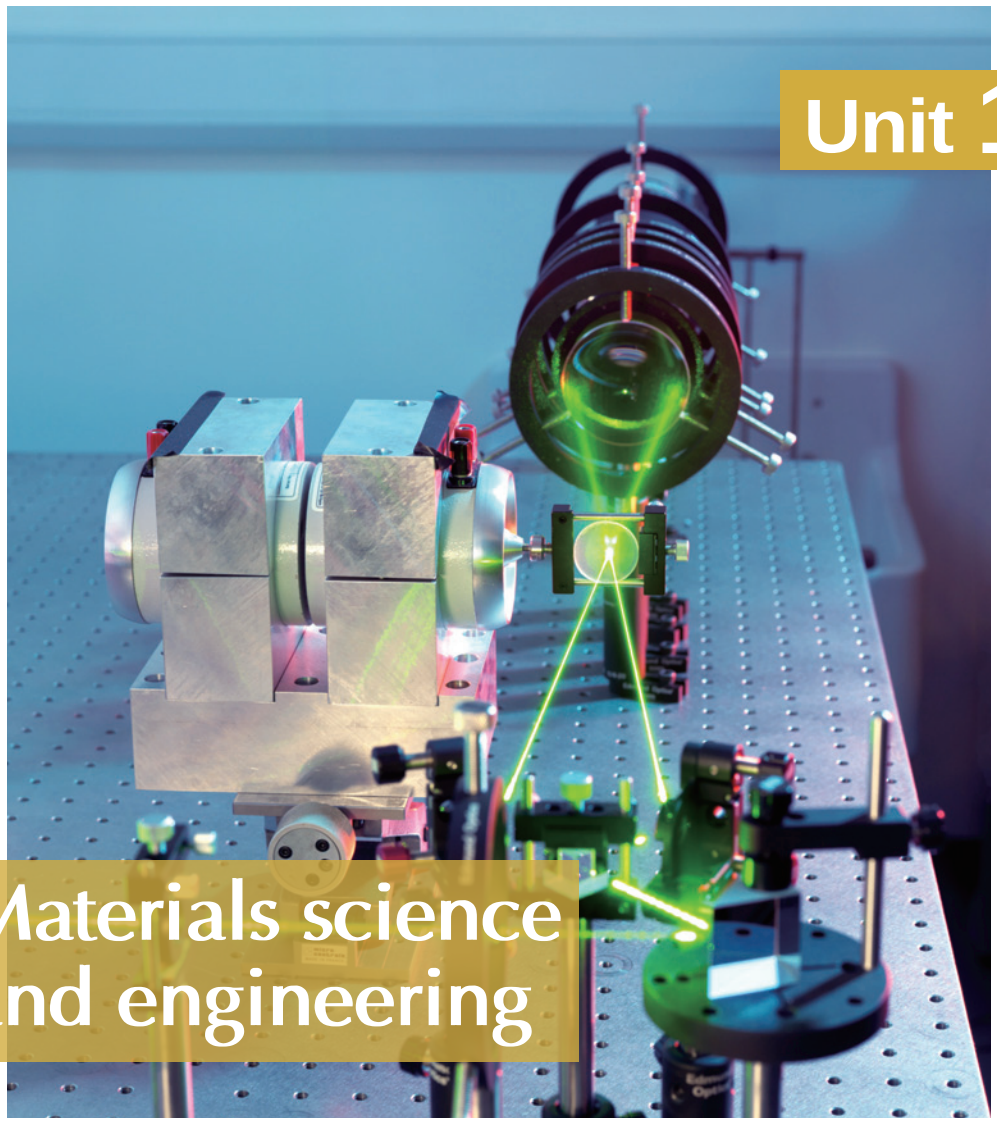
in recent years by flooding from rain as well as rising sea levels. Seeking to keep the city safe, engineers devised a unique method of using rows of mobile gates to keep flood waters at bay. The barriers have the capability to seal off the city of Venice from the rising tides. This project, while not being tremendous in scale, captivates engineers with its unique design and importance to the protection of this famous city.

Palm Islands

8 The Palm Islands is a series of artificial islands in Dubai, United Arab Emirates. They are the Palm Jumeirah, the Palm Jebel Ali and the Palm Deira. These islands are the world's biggest artificial islands. Each of them takes the form of a palm tree, topped by a crescent. There are a large number of residential, leisure and entertainment centers on the islands.

Eurotunnel

9 The tunnel starts from the U.K. and ends in France. The interesting thing is that the tunnel is under the water. Completed and officially opened for travel in 1994, the Eurotunnel consists of three tunnels, two of which are full sized and accommodate rail traffic as well as transport passengers in their motor vehicles and even buses. The third tunnel, smaller and positioned in between the two rail shuttle tunnels, operates as a service tunnel and escape route. The length of this tunnel is about 50 kilometers and about 38 of which is under the sea. The construction of the tunnel was carried out by the engineering firm Transmanche Link and cost an estimated nine billion pounds. At the time of construction, it was the most expensive project ever undertaken in the world.

Unit 1

Materials science and engineering

In this unit, you will learn:

- **Subject-related knowledge:** The history and major concerns of materials science
  Materials engineering and engineers
- **Academic skill:** Searching for information
- **Reading strategy:** Dealing with unknown words (Part I)

Section A

Pre-reading

1 Study the six groups of materials in the right column and try to match them with the corresponding ages listed chronologically in the left column.

Age	Material
Stone Age	high strength alloys
Bronze Age	iron (powered) ore
Iron Age	copper, tin
Steel Age	special rocks, wood, bones, fur
non-ferrous & polymer age	aluminum, titanium, nickel, silicon, plastics, composites
exotic materials age	nanomaterials, biomaterials

2 Discuss the following questions in groups.

1. What are materials according to your understanding?
2. What do you know about the classification of materials?
3. Try to list five commonly encountered engineering materials.

1 From a practical standpoint, material objects are essentially substances that humans use to build things, including solids, liquids, and gases. The properties of materials might not be an exact image of those that their elements possess. Thus, we especially concern ourselves with how elements are structured in macroscopic bodies, what treatments are used during the elaboration of materials, or the physicochemical aggregation of different elements – all activities that condition the properties of materials.

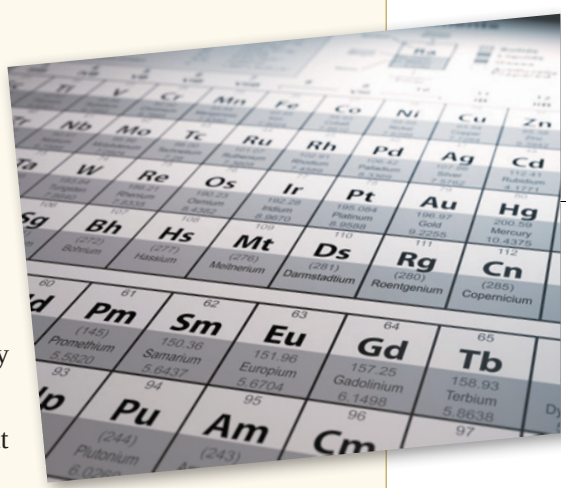
2 The selection, modification, and elaboration of materials to satisfy our needs merge in the foundations of human culture. From the very beginnings of prehistory, humans have manipulated substances so that they would be more useful. To create more useful materials, our forebears wanted to understand and control the composition of materials, and they often succeeded in modifying a material's behavior and properties and in predicting the effects of such manipulations.

3 This task developed over time, beginning as a handicraft that employed empirical and speculative knowledge. The history of materials science and engineering had already begun in the Stone Age

An introduction to materials science

Text A

when stones, wood, clay, and leather began to be manipulated. In the Bronze Age, mankind discovered the value of temperature and used it to modify materials by thermal treatments or by adding other substances. Yet, in spite of technological improvements, materials science remained empirical until the end of the 19th century. Materials science, as we now understand it, began with the appearance of Mendeleev's periodic table.



4 Since that time, some properties of elements that are related to their position in the periodic table began to be explained scientifically. Since the end of the 19th century, the introduction of chemistry, physics, calculus, and modern experimentation has brought the use and profits of materials to a mature status. Currently, thanks to more reliable knowledge of the structure of matter, we can design new materials atom by atom to achieve the properties we want. At last we would have materials that not only satisfy our requirements, but also permit us to create new ones that were hitherto unthinkable.

5 Thanks to this science, we can even speculate about using new, alternative materials to solve socioeconomic problems by avoiding the decimation of natural resources or trying to reach long-range sustained economic development. Conversely, the solution of unsolved problems improves our theoretical knowledge as well as the scope of materials in science and engineering.

6 In this context, materials scientists must analyze how the structure and composition of materials relate to their properties, and the effect of the method

of preparation of a material. Materials engineers examine the preparation, selection, and application of materials in agreement with known and desired properties. Engineers also incorporate technical and structural analysis and examine key concerns: energetic, economic, ecological, aging, etc.

7 For materials science and engineering, changes in physicochemical properties in response to a stimulus are highly significant. These properties can be classified into groups according to the kind of stimulus: mechanical, thermal, electromagnetic, chemical, and scattering.

8 In brief, mechanical properties, such as deformation and fracture, among others, are responses to applied mechanical forces. Thermal properties, like thermal conductivity and heat capacity, are affected by heat fluxes or temperature changes. Electrical properties such as the dielectric constant or conductivity occur in response to electromagnetic fields. Magnetic properties, like different types of magnetism, are also a response to electromagnetic fields. In a similar sense, optical properties, such as the refractive index or absorption, among others, respond to electromagnetic fields having high frequency. Chemical properties, like the chemical affinity, are responses to the existence of reagents in the environment. And the scattering properties are responses to the impact of particles depending on the material's structure.

9 In thinking about properties as a response to determined stimuli, we can group materials into families that facilitate a common analysis to determine the origin of the properties. For example, materials can be classified according to their electrical properties; hence, there are good or poor electrical conductors. This brings us to a taxonomy that permits us to see common features among materials in a family, to understand the basis of a property, and to predict the origin of new materials.

10 In the selective process of materials engineering, the choice of material is limited by the required properties and the available budget. The requisite properties are imposed by what we wish to make from the material, by

environmental conditions, and by the degradation of the material. In this selection, we have to take into account that the usage of materials and environmental conditions will provoke their degradation, which determines the required properties in an environment. When environmental conditions can be controlled, material selection is defined by its usage and the budget. That is, the economy plays a key role in materials engineering.

11 Materials science itself tries to analyze phenomena by the usual activities of contemporary science, and, without relying on economic aspects, to determine how structure, the presence of impurities and defects, production, purification, or mechanical transformation affects material properties.

12 Materials science can also do the converse: As desirable properties are defined, the material that can display them, although it might not exist in nature, is designed. There are well-known examples of this: stainless steel, powders used in metallurgy, ceramic materials with a controlled coefficient of expansion (which can even be zero), conducting plastics, plastics with a high resistance to friction, such as the one used in some aircraft radomes (a word formed from radar dome), or glasses with a saturable transmission coefficient.

13 The continuous development of new materials has also prompted the growth of an innovative industrial sector whose products, such as microelectronics or photonics, have greatly transformed the relationship between humans and their environment. Suffice it to say that with the many appliances that are electronically controlled, with the computer industry, with the substitution of copper by optical fibers in telephone conductors, or with satellite communications, we are challenged to make sense of the socioeconomic impact that these changes imply. Countries need to modify their industrial structure so they can survive the modifications that the new materials technology generates.

New words and expressions

macroscopic /ˌmækrəʊ'skɒpɪk/ *adj.*
large enough to be seen and examined without the aid of magnifying equipment 肉眼可见的；宏观的

elaboration /ɪˌlæbə'reɪʃən/ *n.*
the process of improving and refining sth. 加工

clay /kleɪ/ *n.* 黏土

thermal /'θɜːməl/ *adj.*
relating to heat 热的；热量的

Mendeleev's periodic table 门捷列夫元素周期表

calculus /'kælkjʊləs/ *n.* 微积分

decimation /ˌdesɪ'meɪʃən/ *n.*
the killing or destruction of a large population of a group or species 毁灭；削减

stimulus /'stɪmjʊləs/ *n.*
sth. that makes sth. or someone move or react 刺激；刺激物

electromagnetic /ɪˌlektrəʊmæg'netɪk/ *adj.*
电磁的

scattering /'skætərɪŋ/ *adj.* 散射的

deformation /ˌdiːfɔː'meɪʃən/ *n.*
a change in the shape or form 变形

fracture /'fræktʃə(r)/ *n.*
a break, split, or crack in an object or a material 折断；断裂

conductivity /ˌkɒndʌk'tɪvətɪ/ *n.*
the ability to allow electricity, heat, etc. to travel along or through 传导性

flux /flʌks/ *n.*
a flow or discharge 流量；流出

dielectric constant 介质常数

magnetism /'mægnɪtɪzəm/ *n.*
the physical force that makes two metal objects pull towards each other or push each other apart 磁性；磁力

optical /'ɒptɪkəl/ *adj.* 光学的

refractive /rɪ'fræktɪv/ *adj.* 折射的

reagent /riː'eɪdʒənt/ *n.*
a substance that shows that another substance in a compound exists, by causing a chemical reaction 试剂

taxonomy /tæk'sɒnəmɪ/ *n.*
the system of organizing things into different groups that show their natural relationships, esp. plants or animals（动植物等的）分类学

degradation /ˌdegrə'deɪʃən/ *n.*
the process of changing to a simpler form 分解；降解

impurity /ɪm'pjʊərətɪ/ *n.*
a substance of a low quality that is contained in or mixed with sth. else, making it less pure 杂质

metallurgy /me'tælədʒɪ/ *n.* 冶金（学）

ceramic /sɪ'ræmɪk/ *adj.* 陶瓷的；制陶的

coefficient /ˌkəʊɪ'fɪʃənt/ *n.* 系数

resistance /'rɪ'zɪstəns/ *n.* 抗性；阻力

radome /'reɪdəʊm/ *n.* 天线罩；天线屏蔽器

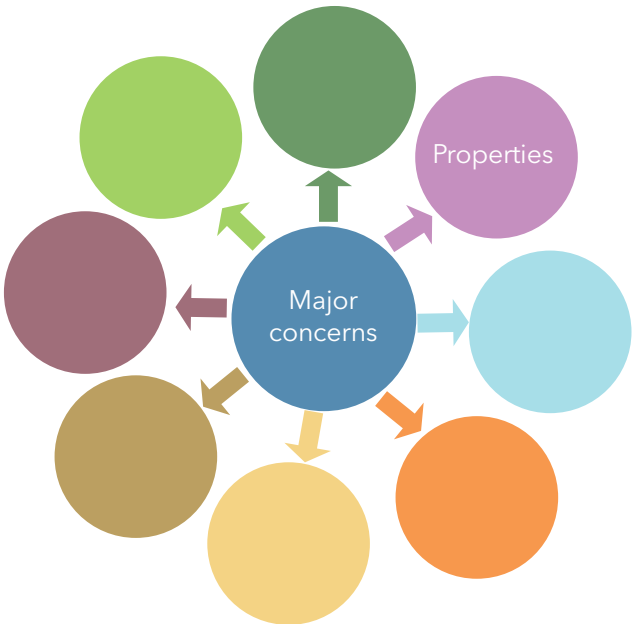
saturable /'sætʃərəbl/ *adj.*
capable of being saturated 能浸透的；可饱和的

microelectronics /'maɪkrəʊɪˌlek'trɒnɪks/ *n.*
微电子学

photonics /fəʊ'tɒnɪks/ *n.* 光子学

Reading comprehension

1 Read Text A and fill in the following graph with major concerns of materials science and engineering.



2 Materials can be classified into five properties according to the kind of stimulus. Read Text A and write down the five properties of materials and find examples as many as possible.

Property of materials	Example

Language focus

1 The words in bold in Column A have different meanings in general English and English for materials science. Discuss with your partner and match them with their possible meanings in Column B.

Column A	Column B
___ 1. We especially concern ourselves with what treatments are used during the **elaboration** of materials.	A. the process in which particles are deflected or diffused
___ 2. They often succeeded in modifying a material's **behavior** and properties.	B. a number expressing a relation or property which remains the same in all circumstances, or for the same substance under the same condition
___ 3. These properties can be classified into groups according to the kind of stimulus: mechanical, thermal, electromagnetic, chemical, and **scattering**.	C. the process of developing sth. in further detail
___ 4. Electrical properties such as the dielectric **constant** or conductivity occur in response to electromagnetic fields.	D. a material or device that conducts or transmits heat or electricity, especially when regarded in terms of its capacity to do this
___ 5. Hence, there are good or poor electrical **conductors**.	E. the way in which a machine or natural phenomenon works or functions

2 Read the following paragraph and fill in the blanks with the common phrases in the field of materials science below.

materials paradigm　properties and performance
science and engineering　failure analysis

In recent years, materials science has become more widely recognized as a specific and distinct field of 1) _____. Many of the most pressing scientific problems humans currently face are the results of the limitations of available materials. Materials scientists emphasize understanding how the processing of a material influences its structure, and thus its 2) _____. This understanding of processing-structure-properties relationships is called the 3) _____. It is used to advance understanding in a variety of research areas, including nanotechnology,

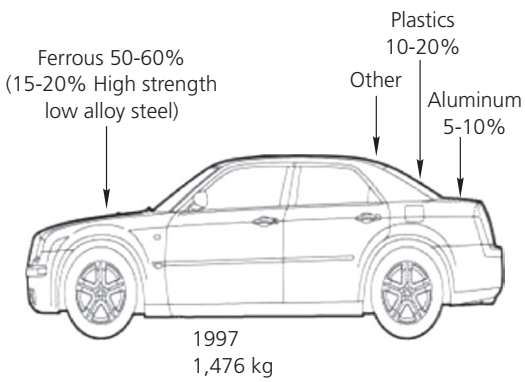
biomaterials and metallurgy. Materials science is also an important part of forensic engineering (法医工程) and 4) _____ – investigating materials, products, structures or components which do not function as intended, causing personal injury or damage to property.

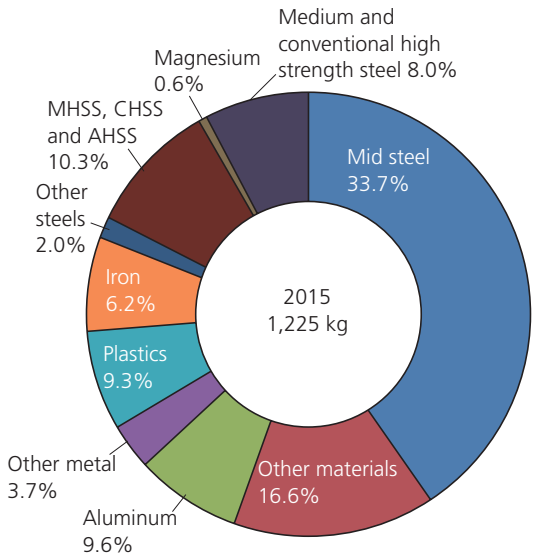
3 **Translate the following paragraph into English.**

人类对材料的选择通常可以定义一个时代，例如石器时代、青铜时代、铁器时代和钢铁时代等。现代材料科学源于冶金业，而冶金业源于采矿业和制陶业，所以说，材料科学是一门历史悠久的工程与应用科学。20世纪以来，材料科学已推动了多项技术的革新。例如，利用金属合金、硅及碳材料的特性来建造空间飞行器，从而实现对太空的探索。诸如塑料、半导体、生物材料等新技术，极大地方便了人类的生活，促进了工业的发展。同时，由于生活和工业的需求，材料科学本身也在不断发展。

Critical thinking

Materials scientists and engineers have to prepare for the constant changes in materials usage. Compare the two pictures and answer the following questions in groups.





1. Describe the changes of major materials used in producing an automobile in the U.S. from 1997 to 2015.
2. Give another example of changes of materials used in some manufactured products over a period of time.
3. What factors may motivate the development and application of new materials?

Researching task

Academic skill: Searching for information

Information can come from virtually anywhere – media, blogs, personal experiences, books, journal and magazine articles, expert opinions, encyclopedias, and web pages, etc.

1. Types of information

Type	Use
Magazine	• To find information or opinions about popular culture. • To find up-to-date information about current events. • To find non-scholarly articles about topics of interest within the subject of the magazine.
Academic journal	• To get help for your scholarly research. • To find out what has been studied on your topic. • To find bibliographies that point to other relevant research.
Database	• To find articles on specific topics. • To find online journals or news articles.
Newspaper	• To find editorials, commentaries, expert or popular opinions. • To find current local, national or world news.
Library catalog	• To find virtually any topic. • To find hard copies of current or back issue of journals, books, newspapers or magazines.
Website	• To find information from all levels of government – central to local. • To find expert or popular opinions. • To find information of various types of media, e.g. illustrations, audio and video information.

2. Searching for information

Author / Title search

Searching by author and / or title obviously assumes that you are searching for a particular author, book or article, probably in either a database or a library catalog. Here are some tips:

- When searching by author, put the author's last name first, e.g. "Kotler, Philip", not "Philip Kotler", if he is from an English-speaking country. Search the author's full name in Chinese order if he is a Chinese. Sometimes, the author could be an organization, so give the full name of the organization as it commonly appears, e.g. "World Bank".
- When searching by title, it helps if you enter the title as correctly as possible.

Keyword search

It is basically a way of searching through subject or topic. Most library catalogs and databases will include an option to search by keyword as an alternative to author and title. The first step of keyword search is to decide the key word(s) or phrase(s). Normally, the word(s) or phrase(s) which can cover the topic you search can be selected as keyword(s). A good research topic usually contains two or three concepts. For example, you need to write a paper on "The Impact of Cognitive Styles on Design Students' Spatial Knowledge". We can break the topic into concepts, like "cognitive styles" and "spatial knowledge", which can be used as keywords. Then type them in a search bar in a database, EBSCOhost for instance. In a database, there are usually two ways of search, i.e., basic search and advanced search.

Basic search (see Fig. 1) generates a large number of sources for you to differentiate, which is an exhausting task. But advanced search (see Fig. 2), which provides more choices for further conditioning, can make the work lighter. There are many variables that can be chosen to refine the search. And you can define the relationship between the keywords by choosing "and", "or" or "not" based on the results you intend to obtain.

Fig. 1 Basic search

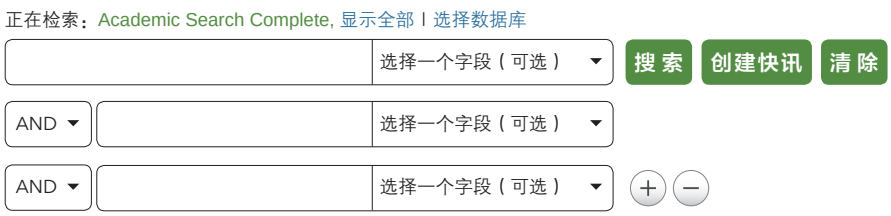


Fig. 2 Advanced search

As "cognitive styles" is a broader topic and "spatial knowledge" is more specific, they can be typed in the upper and middle search bars respectively. More relevant results will appear. You can then refine the search by selecting a specific variable. In this case, "subject" (主题语) can be chosen to filter the results (See Fig. 3).

Fig. 3

Snowball search

It is a good way if your topic has a key work or author. You can trace the citations of that author using a specialized citation database, such as the Social Science Citation Index to obtain other key works or authors. You will follow the stream of research up to the near present and see the way in which the work or the author has influenced the subsequent studies.

3. Evaluating information

Once you have found information that satisfies the requirements of your research, you should evaluate it. Evaluating information encourages you to think critically about the reliability, validity, accuracy, authority, timeliness, point of view or bias of information.

When evaluating information, you can use the five criteria AAOCC, namely, Authority, Accuracy, Objectivity, Currency and Coverage. They can be applied to check all information.

1) Authority of information
   - Who published it?
   - What institution published it?
   - Does the publisher list his or her qualifications?
2) Accuracy of information
   - Who provided it, and can you contact him or her?
   - Does it provide enough details?
   - Has it been cited correctly?
3) Objectivity of information
   - What is the purpose of it, or why was it published?
   - Is it biased?
   - What opinions (if any) are expressed by the author?
4) Currency of information
   - When was it published?
   - When was it updated?
   - How up-to-date is it?
5) Coverage of information
   - Do citations in it complement the research?
   - Is it all text or a balance of text and image?
   - Is it free or is there a fee to obtain it?

Task

Most engineering materials can be divided into five major classes: metallic materials, polymeric materials, ceramic materials, composite materials, and electronic materials. Make use of the Internet and search information of the applications of the five materials with the help of keywords. Then report your findings to the class.

Section B

Reading strategy

Dealing with unknown words (Part I)

The ability to deal with unknown words is a key reading skill in the reading process. It is a vital skill because you are almost certain to find unknown or unfamiliar words in any text. The skill is not necessarily to "know" the words, but to guess the meaning of them so that you can read and understand the whole text. Here are several different ways that can help you guess the meaning of an unknown word.

Guessing by explanation

Sometimes, you will find that the meaning of an unfamiliar word is given to you in the text. In this case, what you need to do is keep on reading and do not stop at the moment when you find an unfamiliar word. And you will find that the meaning of it has already been given to you in the text. For example:

> *The history of materials science and engineering had already begun in the Stone Age when stones, wood, clay, and leather began to be manipulated.*

You might feel confused at the first sight of "Stone Age". But there is a clause immediately after the unfamiliar phrase, that is, "when stones, wood, clay, and leather began to be manipulated". Then you will understand what age the "Stone Age" is.

Guessing by synonyms and antonyms

This is a very useful skill to learn. What you should do here is look at other words which relate to that word and work out what it may mean. These words may be either synonyms (words with a similar meaning) or antonyms (words with an opposite meaning). For example:

> *This brings us to a taxonomy that permits us to see common features among materials in a family, to understand the basis of a property, and to predict the origin of new materials.*

Here you can work out the meaning of "taxonomy" by its synonym "family". All you need to do is read the rest part of the sentence and think of the meaning of it.

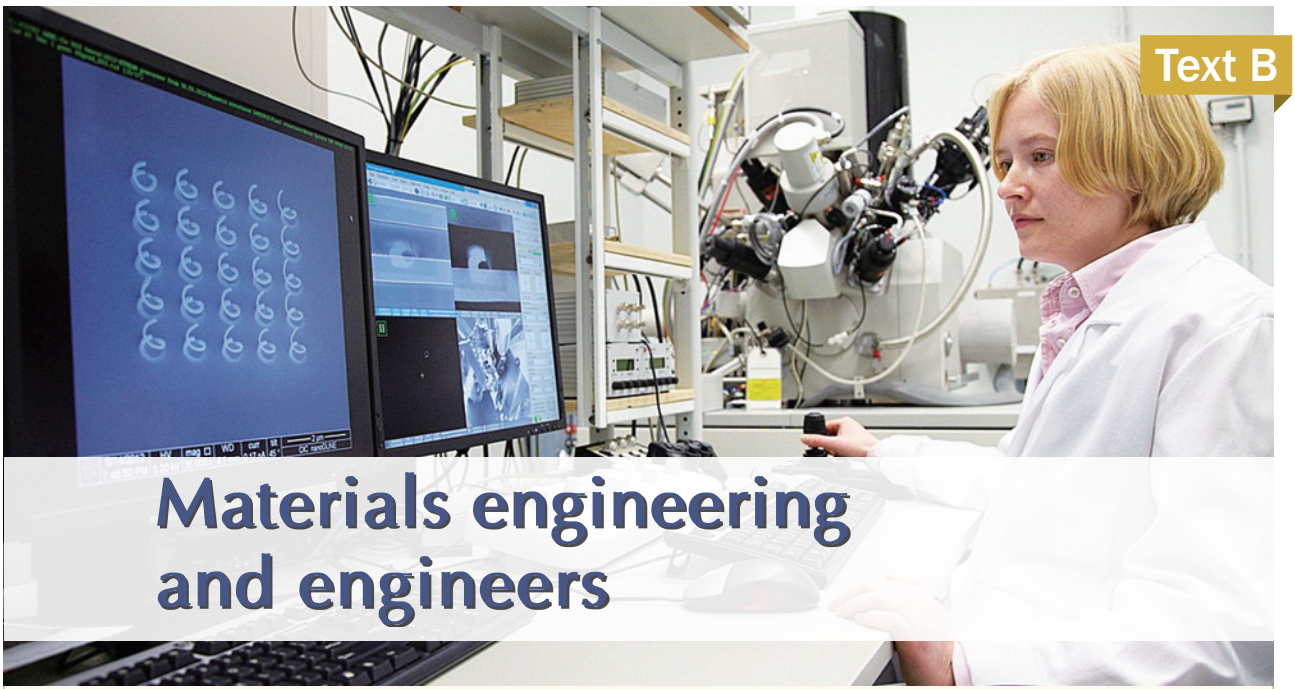
Sometimes, when you come across an unknown word, besides guessing it, you can also ignore the word, especially when the word starts with a capital letter or is in italics, which means that it is in all probability a proper name or a loanword. In this case, you should waste no time in trying to understand the exact meaning of the word. For example:

> *Materials science, as we now understand it, began with the appearance of Mendeleev's periodic table.*

The word "Mendeleev's" is a word that you should learn to ignore because it starts with a capital letter and is therefore a name of a certain person.

Task

Read Text B and apply the skills above to deal with the underlined words.



Text B

Materials engineering and engineers

1 Materials science is primarily concerned with the search for basic knowledge about the structure, properties, and processing of materials. Materials engineering is mainly concerned with the use of fundamental and applied knowledge of materials so that the materials can be converted into necessary products desired by society. Materials science is at the basic knowledge end of the materials knowledge spectrum and materials engineering is at the applied knowledge end. And there is no demarcation line between the two.

2 Materials science heavily relies on physics, chemistry, and engineering fields such as mechanical and electrical engineering. Physical properties of materials are usually the deciding factor in choosing which material should be used for a particular application. Such factors also include composition and structure of materials (chemistry), fracture and stress analysis (mechanical engineering), conductivity (electrical engineering), optical and thermal properties (physics), to name a few. Materials science also deals with processing and production methods,

and many peripheral areas such as crystallography, microscopy, mineralogy, photonics, and powder diffraction. Due to the diversity of the subject areas covered by materials science, the study of it has taken an interdisciplinary trend.

3 The production and processing of materials into finished goods constitutes a large part of our present economy. Engineers, who are knowledgeable about the structure and properties of materials, design manufactured products, select suitable materials and develop the required processing systems for the production.

4 Materials engineers may specialize in understanding specific types of materials. Ceramic engineers develop ceramic materials and the processing methods of making them into useful products, from high-temperature rocket nozzles to glass for LCD flat panel displays. Composites engineers develop materials with special, engineered properties for applications in aircraft, automobiles, etc. Metallurgical engineers specialize in metals, such as steel and aluminum, usually in the alloyed form with additions of other elements to provide specific properties. Plastics engineers develop and test new plastics, known as polymers, for new applications. Semiconductor processing engineers develop new microelectronic materials for computing, sensing, etc. Research and development engineers work to create new materials or modify the properties of existing ones, while design engineers use existing, modified, or new materials to design new products or systems.

5 For engineers, the search for new materials never ends. For example, mechanical engineers search for higher-temperature materials so that jet engines can operate more efficiently. Electrical engineers search for new materials so that electronic devices can operate faster and at higher temperatures. Aerospace engineers search for materials with higher strength-to-weight ratios for aircraft and space vehicles. Chemical engineers look for more highly corrosion resistant materials. These are only a few examples of the

crystallography *n.* 晶体学；结晶学
microscopy *n.* 显微镜学
mineralogy *n.* 矿物学
powder diffraction 粉末衍射
rocket nozzle 火箭发动机喷嘴
flat panel display 平板显示器

search by engineers for new and improved materials. In many cases, what was impossible yesterday is a reality today!

6 Materials engineers generally work in offices where they have access to computers and equipment. Others work in factories or research and development laboratories. Materials engineers may work in teams with scientists and engineers from other backgrounds. They typically work full time and may work overtime hours when necessary.

7 It's not easy to become a materials engineer. In America, materials engineers must have at least a bachelor's degree in materials science and engineering or a related engineering field. Completing internships and cooperative engineering programs while in school can be helpful in getting hired as a materials engineer.

8 Besides, the following five skills are necessary for a materials engineer.

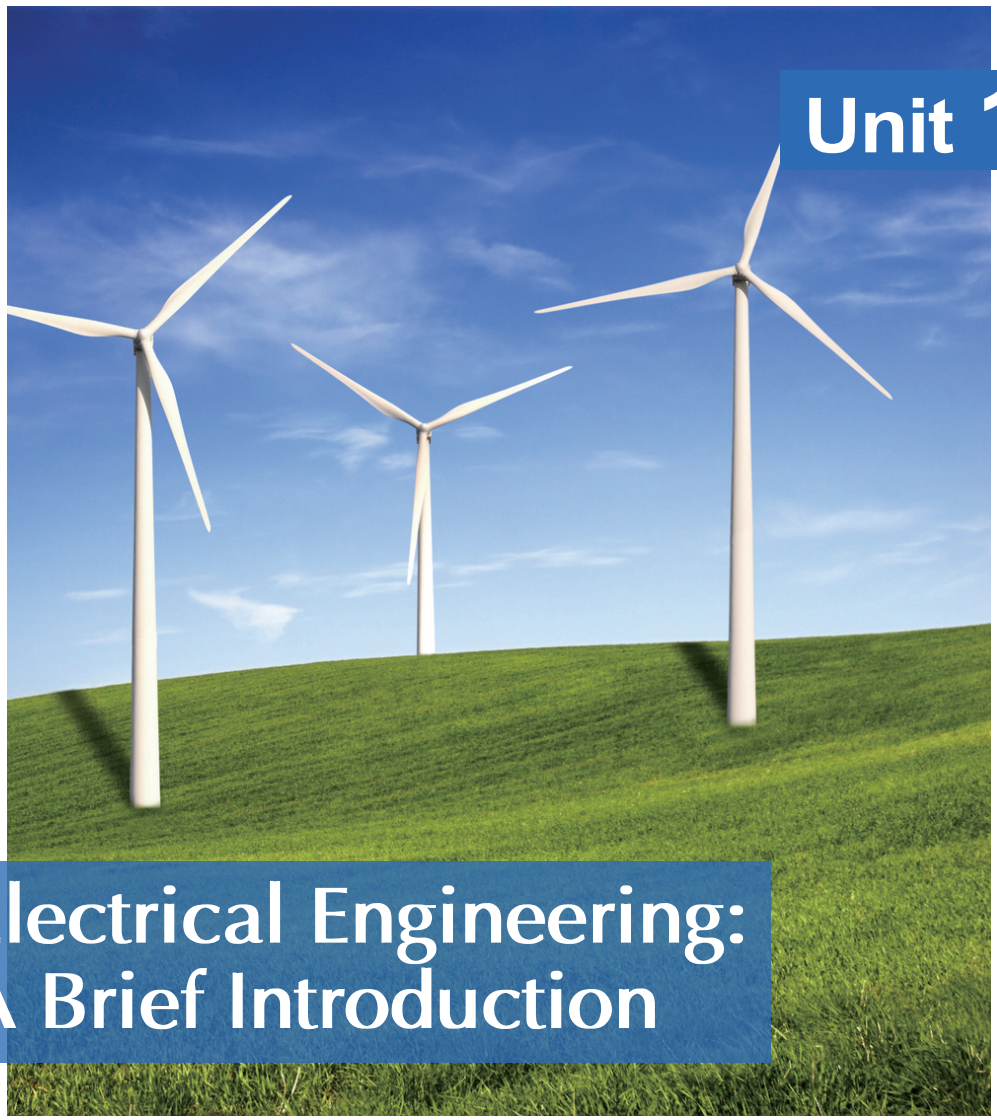
9 Analytical skills. Materials engineers often work on engineering projects, so they have to determine what materials should be used and how they should be structured to withstand different conditions.

10 Math skills. Materials engineers use the principles of calculus and other advanced topics in math for analysis, design, and troubleshooting in their work.

11 Problem-solving skills. Materials engineers are supposed to figure out why a product might have failed, design a solution, and then conduct tests to make sure that the product does not fail again. That means they should be able to identify the root cause when many factors could be at fault.

12 Communication skills. While working with technicians, technologists, and other engineers, materials engineers should be able to state concepts and directions clearly. When speaking with managers, who may not have an engineering background, they should also be able to communicate effectively.

13 Writing skills. More often than not, materials engineers need to make plans and reports, both of which should be clearly understood. Therefore, a materials engineer is always a good writer.



Unit 1

Electrical Engineering: A Brief Introduction

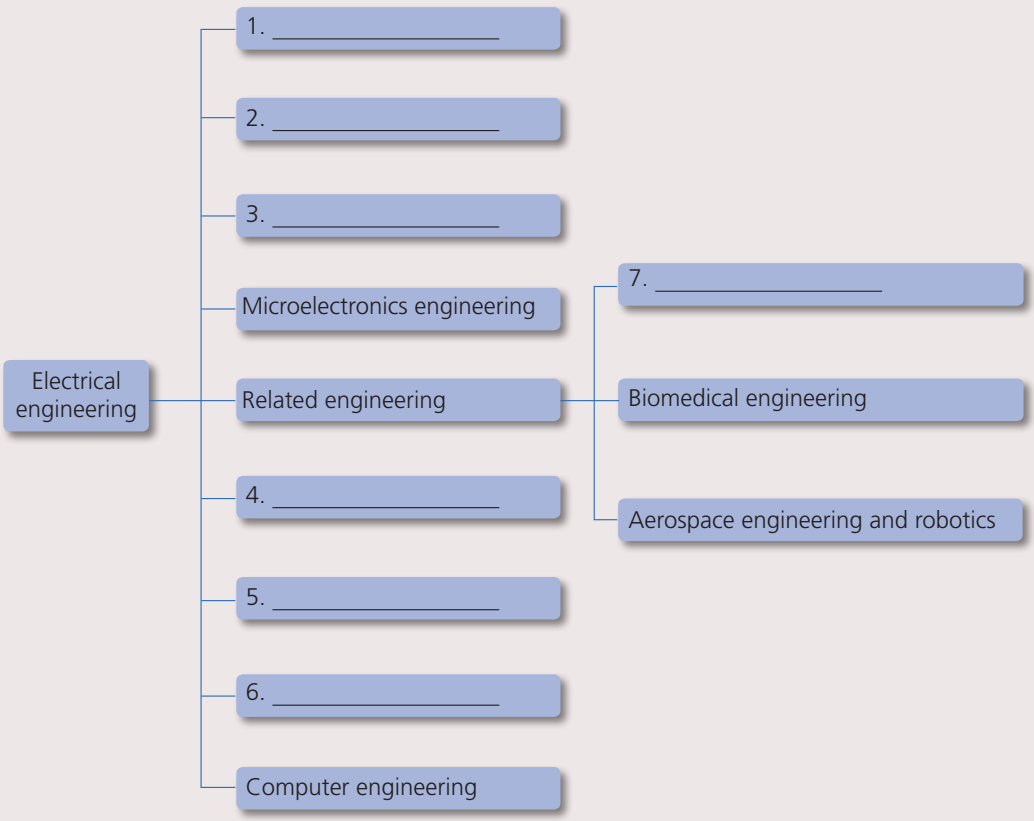
In this unit, you will learn:

- **Subject-related knowledge:** The definition of electrical engineering
  A brief history of electrical engineering
- **Academic skill:** Searching for information
- **Reading strategy:** Dealing with unknown words (Part I)

Section A

Pre-reading

1 Electrical engineering has many sub-disciplines, the most common of which are listed below. Work in groups and fill in the blanks.



2 Discuss the following questions with your partner.

1. What is electricity? What would your life be without electricity?
2. The applications of electrical engineering are very common in our daily life. List at least five of them.

What Is Electrical Engineering?

Text A

1 Electrical engineering is one of the newer branches of engineering, and dates back to the late 19th century. It is the branch of engineering that deals with the technology of electricity. Electrical engineers work on a wide range of components, devices and systems, from tiny microchips to huge power station generators.

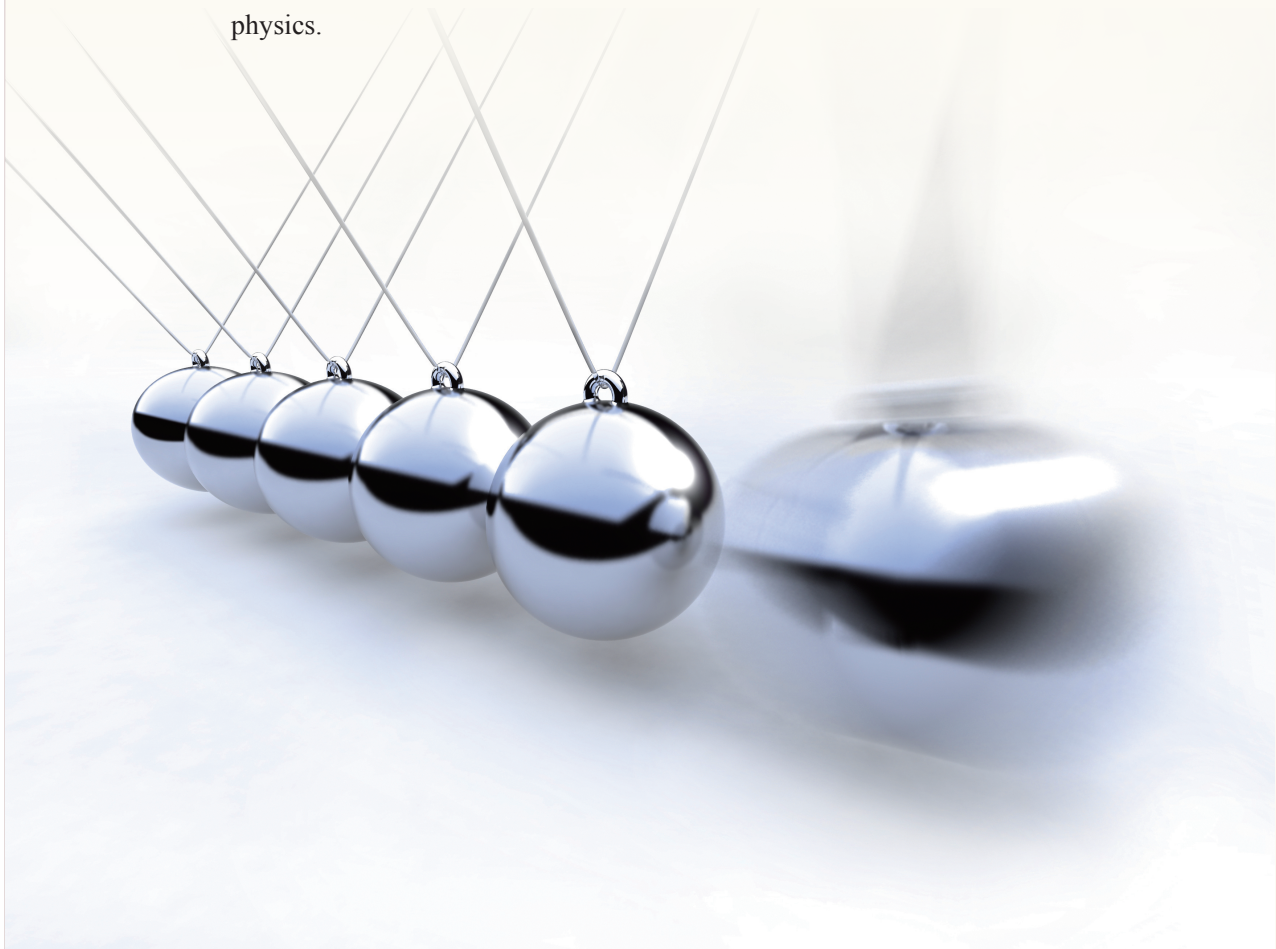
2 Early experiments with electricity included primitive batteries and static charges. However, the actual design, construction and manufacturing of useful devices and systems began with the implementation of Michael Faraday's Law of Induction, which essentially states that the voltage in a circuit is proportional to the rate of change in the magnetic field through the circuit. This law applies to the basic principles of the electric generator, the electric motor and the transformer. The advent of the modern age is marked by the introduction of electricity to homes, businesses and industry, all of which were made possible by electrical engineers.

3 Some of the most prominent pioneers in electrical engineering include Thomas Edison (electric light bulb), George Westinghouse (alternating current, AC), Nikola Tesla (induction motor), Guglielmo Marconi (radio) and Philo T. Farnsworth (television). These innovators turned ideas and concepts about electricity into practical devices and systems that ushered in the modern age.

4 Since its early beginnings, the field of electrical engineering has grown and branched out into a number of specialized categories, including power generation and transmission systems, motors, batteries, digital computers and control systems. Electrical engineering also includes electronics, which

has itself branched into an even greater number of subcategories, such as radio frequency (RF) systems, telecommunications, remote sensing, signal processing, digital circuits, microelectronics, instrumentation, audio, video and optoelectronics.

5 The field of electronics was born with the invention of the thermionic valve diode vacuum tube in 1904 by John Ambrose Fleming. The vacuum tube basically acts as a current amplifier by outputting a multiple of its input current. It was the foundation of all electronics, including radios, television and radar, until the mid-20th century. It was largely supplanted by the transistor, which was developed in 1947 at AT&T's Bell Laboratories by William Shockley, John Bardeen and Walter Brattain, for which they received the 1956 Nobel Prize in physics.



What does an electrical engineer do?

6 "Electrical engineers design, develop, test and supervise the manufacturing of electrical equipment, such as electric motors, radar and navigation systems, communications systems and power generation equipment," states the U.S. Bureau of Labor Statistics (BLS). "Electronics engineers design and develop electronic equipment, such as broadcast and communications systems – from portable music players to global positioning systems (GPS)."

7 If it's a practical, real-world device that produces, conducts or uses electricity, in all likelihood, it was designed by an electrical engineer. Additionally, engineers may conduct or write the specifications for destructive or nondestructive testing of the performance, reliability and long-term durability of devices and components.

8 Today's electrical engineers design electrical devices and systems using basic components such as conductors, coils, magnets, batteries, switches, resistors, capacitors, inductors, diodes and transistors. Nearly all electrical and electronic devices, from the generators at an electric power plant to the microprocessors in your phone, use these few basic components.

9 Critical skills needed in electrical engineering include an in-depth understanding of electrical and electronic theory, mathematics and materials. This knowledge allows engineers to design circuits to perform specific functions and meet requirements for safety, reliability and energy efficiency, and to predict how they will behave, before a hardware design is implemented. Sometimes, though, circuits are constructed on "breadboards", or prototype circuit boards made on computer numeric controlled (CNC) machines for testing before they are put into production.

10 Electrical engineers are increasingly relying on computer-aided design (CAD) systems to create schematics and lay out circuits. They also use computers to simulate how electrical devices and systems will function. Computer

simulations can be used to model a national power grid or a microprocessor; therefore, proficiency with computers is essential for electrical engineers. In addition to speeding up the process of drafting schematics, printed circuit board (PCB) layouts and blueprints for electrical and electronic devices, CAD systems allow for quick and easy modifications of designs and rapid prototyping using CNC machines. A comprehensive list of necessary skills and abilities for electrical and electronics engineers can be found at MyMajors.com.

Electrical engineering jobs and salaries

11 Electrical and electronics engineers work primarily in research and development industries, engineering services firms, manufacturing and the federal government, according to the BLS. They generally work indoors, in offices, but they may have to visit sites to observe a problem or a piece of complex equipment, the BLS says.

12 Manufacturing industries that employ electrical engineers include automotive, marine, railroad, aerospace, defense, consumer electronics, commercial construction, lighting, computers and components, telecommunications and traffic control. Government institutions that employ electrical engineers include transportation departments, national laboratories and the military.

13 Most electrical engineering jobs require at least a bachelor's degree in engineering. Many employers, particularly those that offer engineering consulting services, also require state certification as a professional engineer. Additionally, many employers require certification from the Institute of Electrical and Electronics Engineers (IEEE) or the Institution of Engineering and Technology (IET). A master's degree is often required for promotion to management, and ongoing education and training are needed to keep up with advances in technology, testing equipment, computer hardware and software, and government regulations.

14 As of July 2014, the salary range for a newly graduated electrical engineer with a bachelor's degree is $55,570 to $73,908, according to Salary.com. The range for a mid-level engineer with a master's degree and five to 10 years of experience is $74,007 to $108,640, and the range for a senior engineer with a master's or doctorate and more than 15 years of experience is $97,434 to $138,296. Many experienced engineers with advanced degrees are promoted to management positions or start their own businesses where they can earn even more.

The future of electrical engineering

15 Employment of electrical and electronics engineers is projected to grow by 4% between now and 2022, because of these professionals' "versatility in developing and applying emerging technologies" as the BLS says.

16 The applications for these emerging technologies include studying red electrical flashes, called sprites, which hover above some thunderstorms. Victor Pasko, an electrical engineer at Penn State, and his colleagues have developed a model for how the strange lightning evolves and disappears.

17 Another electrical engineer, Andrea Alù, of the University of Texas at Austin, is studying sound waves and has developed a one-way sound machine. "I can listen to you, but you cannot detect me back; you cannot hear my presence." Alù told LiveScience in a 2014 article.

18 And Michel Maharbiz, an electrical engineer at the University of California, Berkeley, is exploring ways to communicate with the brain wirelessly.

19 The BLS states, "The rapid pace of technological innovation and development will likely drive demand for electrical and electronics engineers in research and development, an area in which engineering expertise will be needed to develop distribution systems related to new technologies."

New words and expressions

component /kəm'pəʊnənt/ *n.*
one of several parts that together make up a whole machine 零件

generator /'dʒenəreɪtə(r)/ *n.*
an engine that converts mechanical energy into electrical energy by electromagnetic induction 发电机

charge /tʃɑːdʒ/ *n.*
the amount of electricity that is put into a battery or carried by a substance 电荷；电量

implementation /ˌɪmplɪmen'teɪʃən/ *n.*
the act of accomplishing some aim or executing some order 履行；执行；实施

voltage /'vəʊltɪdʒ/ *n.*
electrical force measured in volts 电压；伏特数

circuit /'sɜːkɪt/ *n.*
the complete path of wires and equipment along which an electric circuit flows 电路

transformer /træns'fɔːmə(r)/ *n.*
a piece of electrical equipment which changes a voltage to a higher or lower voltage 变压器

advent /'ædvənt/ *n.*
the coming of an important event, person, invention, etc. 出现；到来

prominent /'prɒmɪnənt/ *adj.*
conspicuous in position and importance 显著的；突出的；著名的

AC abbr. (alternating current) 直流电

usher /'ʌʃə(r)/ *vt.*
to cause sth. new to start, or to be at the start of sth. new 宣告；开创

transmission /trænz'mɪʃən/ *n.* 传输

instrumentation /ˌɪnstrʊmen'teɪʃən/ *n.*
the set of instruments used to help in controlling a machine 使用仪器；仪器仪表

optoelectronics /'ɒptəʊɪˌlek'trɒnɪks/ *n.*
光电子学

thermionic /ˌθɜːmɪ'ɒnɪk/ *adj.*
热电子的；热离子的

valve /vælv/ *n.*
a closed glass tube used to control the flow of electricity in old radios, television, etc. 电子管；真空管

diode /'daɪəʊd/ *n.*
an electric device in which the electric current passes in one direction only （电子）二极管

vacuum /'vækjuəm/ *n.*
a space that is completely empty of all gas, especially one from which all the air has been taken away 真空

current /'kʌrənt/ *n.*
a flow of electricity through a conductor 电流

supplant /sə'plɑːnt/ *vt.*
to take the place of, or move into the position of 代替；取代；把……排挤掉

transistor /træn'sɪstə(r)/ *n.*
a semiconductor device capable of controlling the flow of electricity 晶体管

capacitor /kə'pæsɪtə(r)/ *n.*
an electrical device characterized by its capacity to store an electric charge 电容器

inductor /ɪn'dʌktə(r)/ *n.*
an electrical device (typically a conducting coil) that introduces inductance into a circuit 感应器

prototype /ˈprəʊtəʊtaɪp/ *n.*
a standard or typical example 原型；蓝本

numeric /njuːˈmerɪk/ *adj.*
measured or expressed in numbers 数字的；数值的

schematic /skɪˈmætɪk/ *n.* 图表；电路图

simulate /ˈsɪmjʊleɪt/ *vt.*
to create a representation or model, or reproduce someone's behavior or looks 模拟；模仿

amplifier /ˈæmplɪfaɪə(r)/ *n.*
electronic equipment that increases the strength of signals passing through it 放大器

grid /grɪd/ *n.*
a system of high tension cables by which electrical power is distributed throughout a region 输电网

prototyping /ˌprəʊtəʊˈtaɪpɪŋ/ *n.*
样机（原型机）制造；样机研究；原型机设计

versatility /ˌvɜːsəˈtɪlətɪ/ *n.*
having a wide variety of skills 多用途；多才多艺

emerging /ɪˈmɜːdʒɪŋ/ *adj.*
coming into existence 新兴的

hover /ˈhɒvə(r)/ *vi.*
to hang in the air, or to move to and fro 盘旋；徘徊

expertise /ˌekspɜːˈtiːz/ *n.*
special skill or knowledge that is acquired by training, study or practice 专门知识或技能

distribution /ˌdɪstrɪˈbjuːʃən/ *n.*
the act of distributing or spreading or apportioning 分配；分布

branch out (into) 涉足；拓展

lay out 展示；设计；安排

Reading comprehension

Fill in the blanks based on the information from Text A with the help of the initial letters given and figure out the paragraphs.

1. Electrical engineering is about the technology of e_____ which dates back to the late 19th century. (Para. ___)
2. Law of Induction, written by Michael Faraday, states that the v_____ in a circuit is proportional to the rate of change in the magnetic field through the circuit. (Para. ___)
3. Electrical engineering has itself branched into an even greater number of subcategories, such as r_____ frequency (RF) systems, telecommunications, remote sensing, signal processing and digital circuits. (Para. ___)
4. It was the invention of the v_____ tube that made electronics widespread and practical in the first half of the 20th century. (Para. ___)
5. The t_____, an IEEE milestone, revolutionized the field of electronics and paved the way for smaller and cheaper radios, calculators and computers. (Para. ___)

Language focus

1 **Match the items in Column A with appropriate items in Column B to make fixed phrases in the field of electrical engineering and translate them into Chinese in Column C. Then fill in the blanks of the following sentences with these fixed phrases.**

Column A	Column B	Column C
___ 1. electric	A. system	_____
___ 2. static	B. processing	_____
___ 3. current	C. generator	_____
___ 4. transmission	D. charge	_____
___ 5. signal	E. field	_____
___ 6. magnetic	F. amplifier	_____

1. The electricity that is collected on insulators is called _____ because the electricity is at rest.
2. The technology of detecting weak _____ represents the highest level of today's magnetic measurement.
3. A(n) _____ is usually driven by a steam turbine (涡轮机), and this is how most electricity is produced today.
4. A method and apparatus (装置) for _____ which enables data compression and recovery with high transmission efficiency is disclosed.
5. A control circuit which is composed of a capacitor and a _____ is connected in a coil circuit in series.
6. The faults of HVDC power _____ make the electrical characteristics of AC system more complex.

2 **Figure out the exact meanings of words in bold in the following groups of sentences, and pay attention to their exact meanings in specialized subject areas.**

1. circuit

1) During the car racing, the two cars finished up in a run-off area, clear of

the **circuit**, and that was a mercy. _____

2) There is an internal **circuit** breaker to protect the instrument from overload. _____

3) It is a common problem, the one I'm asked about most when I'm on the lecture **circuit**. _____

2. generator

1) Wicked environment and exceeding use has high requirements to corrosion protection of the wind power **generator** set. _____

2) The results and analysis in this paper provide useful basis for the design and running of once-through steam **generator**. _____

3) Among the top 10 electric power companies in China, State Grid Corporation of China is the largest electricity **generator**. _____

3. versatility

1) Its **versatility**, flexibility, and wide range of implementations and environments make it difficult to describe procedures to cover all cases. _____

2) **Versatility** is another of your strong points, but don't overdo it by having too many irons in the fire. _____

4. branch

1) After the storm last week there were **branches** and twigs all over the ground along the streets of the old town. _____

2) Electrical engineering is a **branch** of engineering science that studies the uses of electricity and the equipment for power generation and distribution and the control of machines and communication. _____

3) Coincident with the talks, Industrial & Commercial Bank was permitted to open a **branch** in another country. _____

3 **Fill the blanks with the words and phrases below. Change the form if necessary. Each word or phrase can be used only once.**

optoelectronics advent branch out simulate
instrumentation supplant schematics lay out

1. With the _____ of cloud computing we quickly realized that this metered resource usage had another important management perspective – costing.

2. The field of electrical engineering has _____ into many specialized categories, such as power generation and transmission systems, batteries, digital computers and control systems.
3. The development of microcomputers and automatic technologies has greatly promoted the intelligent functions and automatization of industrial _____.
4. You can bypass this limitation by using the techniques to _____ responsive communication between the server and client.
5. If, in the next century, electronic markets begin to _____ companies as the organizing force behind economic exchange, we will confront these dilemmas anew.
6. When we _____ the power supply system of the town, we reckoned on one transformer per four blocks.
7. Subjects of the study include Ohm's law (欧姆定律), reading electrical _____, using test equipment, as well as the maintenance and troubleshooting of electrical equipment.
8. Microelectronics (微电子学), _____ and photonics play an important role in the modern optical communication and optical sensor (传感器) industry.

4 Translate the following paragraph into English.

电气工程是现代科技领域中的核心学科之一。电气工程的发达程度代表着国家的科技进步水平，因此电气工程的教育和科研一直在发达国家的大学中占据十分重要的地位。电力是发展生产和提高人类生活水平的重要物质基础，电力的应用在不断深化和发展。就目前国际水平而言，在今后相当长的时期内，电力的需求将不断增长，社会对电气工程及其自动化科技工作者的需求将呈上升态势。

Critical thinking

1 Transistors were invented in New Jersey in 1947. The invention was the culmination of a long-running effort to develop a viable alternative to the vacuum tube using semiconductor (半导体) technology. What is a transistor? Compared to vacuum tubes, what are the advantages of transistors?

2 Work in groups to discuss what the life is likely to be in the future with the rapid development of electrical engineering and its automation, and then each group gives a short report to the class.

Research task

Academic skill: Searching for information

Information can come from virtually anywhere – media, blogs, personal experiences, books, journal and magazine articles, expert opinions, encyclopedias, and web pages, etc.

1. Types of information

Type	Use
Magazine	• To find information or opinions about popular culture. • To find up-to-date information about current events. • To find non-scholarly articles about topics of interest within the subject of the magazine.
Academic journal	• To get help for your scholarly research. • To find out what has been studied on your topic. • To find bibliographies that point to other relevant research.
Database	• To find articles on specific topics. • To find online journals or news articles.
Newspaper	• To find editorials, commentaries, expert or popular opinions. • To find current local, national or world news.
Library catalog	• To find virtually any topic. • To find hard copies of current or back issue of journals, books, newspapers or magazines.
Website	• To find information from all levels of government – central to local. • To find expert or popular opinions. • To find information of various types of media, e.g. illustrations, audio and video information.

2. Searching for information

Author / Title search

Searching by author and / or title obviously assumes that you are searching for a particular author, book or article, probably in either a database or a library catalog. Here are some tips:

- When searching by author, put the author's last name first, e.g. "Kotler, Philip", not "Philip Kotler", if he is from an English-speaking country. Search the author's full name in Chinese order if he is a Chinese. Sometimes, the

author could be an organization, so give the full name of the organization as it commonly appears, e.g. "World Bank".

- When searching by title, it helps if you enter the title as correctly as possible.

Keyword search

It is basically a way of searching through subject or topic. Most library catalogs and databases will include an option to search by keyword as an alternative to author and title. The first step of keyword search is to decide the key word(s) or phrase(s). Normally, the word(s) or phrase(s) which can cover the topic you search can be selected as keyword(s). A good research topic usually contains two or three concepts. For example, you need to write a paper on "The Impact of Cognitive Styles on Design Students' Spatial Knowledge". We can break the topic into concepts, like "cognitive styles" and "spatial knowledge", which can be used as keywords. Then type them in a search bar in a database, EBSCOhost for instance. In a database, there are usually two ways of search, i.e. basic search and advanced search.

Basic search (see Fig. 1) generates a large number of sources for you to differentiate, which is an exhausting task. But advanced search (see Fig. 2), which provides more choices for further conditioning, can make the work lighter. There are many variables that can be chosen to refine the search. And you can define the relationship between the keywords by choosing "and", "or" or "not" based on the results you intend to obtain.

Fig. 1 Basic search

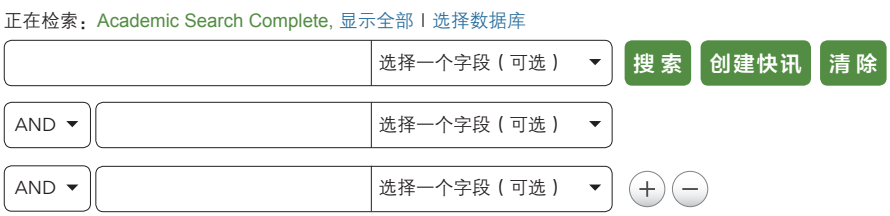


Fig. 2 Advanced search

As "cognitive styles" is a broader topic and "spatial knowledge" is more specific, they can be typed in the upper and middle search bars respectively. More relevant results will appear. You can then refine the search by selecting a specific variable. In

this case, "subject" (主题语) can be chosen to filter the results (See Fig. 3).

Fig. 3

Snowball search

It is a good way if your topic has a key work or author. You can trace the citations of that author using a specialized citation database, such as the Social Science Citation Index to obtain other key works or authors. You will follow the stream of research up to the near present and see the way in which the work or the author has influenced the subsequent studies.

3. Evaluating information

Once you have found information that satisfies the requirements of your research, you should evaluate it. Evaluating information encourages you to think critically about the reliability, validity, accuracy, authority, timeliness, point of view or bias of information.

When evaluating information, you can use the five criteria AAOCC, namely, Authority, Accuracy, Objectivity, Currency and Coverage. They can be applied to check all information.

1) Authority of information
   - Who published it?
   - What institution published it?
   - Does the publisher list his or her qualifications?
2) Accuracy of information
   - Who provided it, and can you contact him or her?
   - Does it provide enough details?
   - Has it been cited correctly?

3) Objectivity of information
   - What is the purpose of it, or why was it published?
   - Is it biased?
   - What opinions (if any) are expressed by the author?
4) Currency of information
   - When was it published?
   - When was it updated?
   - How up-to-date is it?
5) Coverage of information
   - Do citations in it complement the research?
   - Is it all text or a balance of text and image?
   - Is it free or is there a fee to obtain it?

Task

Now you know what electrical engineering is and what an electrical engineer does. Work in groups and search some information on the **electrical supply system of high-speed rail**. Evaluate the information using the AAOCC criteria. Then write down where, how and what you have found and share them in groups.

	Where did you search?	How did you search?	What have you found?
1			
2			
3			

Section B

Reading strategy

Dealing with unknown words (Part I)

The ability to deal with unknown words is a key reading skill in the reading process. It is a vital skill because you are almost certain to find unknown or unfamiliar words in any text. The skill is not necessarily to "know" the words, but to guess the meaning of them so that you can read and understand the whole text. Here are several different ways that can help you guess the meaning of an unknown word.

Guessing by explanation

Sometimes, you will find that the meaning of an unfamiliar word is given to you in the text. In this case, what you need to do is do not stop at the moment you find an unfamiliar word and keep on reading. Typically, you can get the meaning from a phrase immediately after the unfamiliar word. For example:

> *The Intel 4004 was a four-bit processor released in 1971, but in 1973 the Intel 8080, an eight-bit processor, made the first personal computer, the Altair 8800, possible.*

Here you should understand that meaning of "Intel 8080" by reading following "an eight-bit processor".

Guessing by synonyms and antonyms

This is a very useful skill to learn. What you should do here is look at other words which relate to that word and work out what it may mean. These words may be either synonyms (words with a similar meaning) or antonyms (words with an opposite meaning). For example:

> *Victor Pasko, an electrical engineer at Penn State, and his colleagues have developed a model for how the strange lightning evolves and disappears.*

Here you can work out the meaning of "evolve" by antonym "disappear". All you need to do is to read the rest part of the sentence and think of the meaning of it.

Guessing by common sense and experience

Sometimes, when you come across an unknown word, besides guessing it, you can also ignore the word, especially when the word starts with a capital letter or is in italics, which means that it is in all probability a proper name or a loanword. In this case, you should waste no time in trying to understand the exact meaning of the word. For example:

> *"Electrical engineers design, develop, test and supervise the manufacturing of electrical equipment, such as electric motors, radar and navigation systems, communications systems and power generation equipment," states the U.S. Bureau of Labor Statistics (BLS).*

Here the word "bureau" is a word that you should learn to ignore because it starts with a capital letter and is therefore a word may not influence the overall meaning of the sentence.

Task

Read Text B and apply the skills above to deal with the underlined words.

Text B

A Brief History of Electrical Engineering

1 Electricity has been a subject of scientific interest since at least the early 17th century. A prominent early electrical scientist was William Gilbert who was the first to draw a clear distinction between magnetism and static electricity and is credited with establishing the term electricity. He also designed the versorium: a device that detected the presence of statically charged objects. Then in 1762 Swedish professor Johan Carl Wilcke invented, and in 1775 Alessandro Volta improved, a device (for which Volta coined the name electrophorus) that produced a static electric charge, and by 1800 Volta had developed the voltaic pile, a forerunner of the electric battery.

2 In the 19th century, research into the subject started to intensify. Notable developments in this century include the work of Georg Ohm, who in 1827 quantified the relationship between the electric current and potential difference in a conductor, of Michael Faraday, the discoverer of electromagnetic induction in 1831, and of James Clerk Maxwell, who in 1873 published a unified theory of electricity and magnetism in his treatise *Electricity and Magnetism*.

3 Electrical engineering became a profession in the later 19th century. Practitioners had created a global electric telegraph network and the first professional electrical engineering institutions were founded in the U.K. and U.S.A. to support the new discipline. Although it is impossible to precisely pinpoint a first electrical engineer, Francis Ronalds stands ahead of the field, who created the first working electric telegraph system in 1816 and documented his vision of how the world could be transformed by electricity.

electromagnetic *adj.* 电磁的

Over 50 years later, he joined the new Society of Telegraph Engineers (soon to be renamed the Institution of Electrical Engineers) where he was regarded by other members as the first of their cohort. By the end of the 19th century, the world had been forever changed by the rapid communication made possible by the engineering development of land-lines, submarine cables, and, from about 1890, wireless telegraphy.

4 Practical applications and advances in such fields created an increasing need for standardized units of measure. They led to the international standardization of the units of volt, ampere, coulomb, ohm, farad, and henry. This was achieved at an international conference in Chicago in 1893. The publication of these standards formed the basis of future advances in standardization in various industries, and in many countries the definitions were immediately recognized in relevant legislation.

5 During these years, the study of electricity was largely considered to be a subfield of physics. That's because early electrical technology was electromechanical in nature. The Technische Universität Darmstadt founded the world's first department of electrical engineering in 1882. The first electrical engineering degree program was started at Massachusetts Institute of Technology (MIT) in the physics department under Professor Charles Cross, though it was Cornell University to produce the world's first electrical engineering graduates in 1885. The first course in electrical engineering was taught in 1883 in Cornell's Sibley College of Mechanical Engineering and Mechanic Arts. It was not until about 1885 that Cornell President Andrew Dickson White established the first Department of Electrical Engineering in the United States. In the same year, University College London founded the first chair of electrical engineering in Great Britain. Professor Mendell P. Weinbach at University of Missouri soon followed suit by establishing the electrical engineering department in 1886. Afterwards, universities and institutes of technology gradually started to offer electrical engineering programs to their students all over the world.

6 During these decades, the use of electrical engineering increased dramatically. In 1882, Thomas Edison switched on the world's first large-scale electric power network that provided 110 volts – direct current (DC) – to 59 customers on Manhattan Island in New York City. In 1884, Sir Charles Parsons invented the steam turbine allowing for more efficient electric power generation. Alternating current with its ability to transmit power more efficiently over long distances via the use of transformers, developed rapidly in the 1880s and 1890s with transformer designs by Károly Zipernowsky, Ottó Bláthy and Miksa Déri (later called ZBD transformers), Lucien Gaulard, John Dixon Gibbs and William Stanley, Jr. Practical AC motor designs including induction motors were independently invented by Galileo Ferraris and Nikola Tesla and further developed into a practical three-phase form by Mikhail Dolivo-Dobrovolsky and Charles Eugene Lancelot Brown. Charles Steinmetz and Oliver Heaviside contributed to the theoretical basis of alternating current engineering. The spread in the use of AC set off in the United States, which has been called the "War of Currents" between a George Westinghouse backed AC system and a Thomas Edison backed DC power system, with AC being adopted as the overall standard.

7 During the development of radio, many scientists and inventors contributed to radio technology and electronics. The mathematical work of James Clerk Maxwell during the 1850s had shown the relationship of different forms of electromagnetic radiation including possibility of invisible airborne waves (later called "radio waves"). In his classic physics experiments of 1888, Heinrich Hertz proved Maxwell's theory by transmitting radio waves with a spark-gap transmitter, and detected them by using simple electrical devices. Other physicists experimented with these new waves and in the process developed devices for transmitting and detecting them. In 1895, Guglielmo Marconi began work on a way to adapt the known methods of transmitting and detecting these

DC *abbr.* (direct current) 直流电
power system 电力系统

"Hertzian waves" into a purpose-built commercial wireless telegraphic system. Early on, he sent wireless signals over a distance of one and a half miles. In December 1901, he sent wireless waves that were not affected by the curvature of the Earth. Marconi later transmitted the wireless signals across the Atlantic between Poldhu, Cornwall, and St. John's, Newfoundland, a distance of 2,100 miles (3,400 km).

8 In 1897, Karl Ferdinand Braun introduced the cathode ray tube as part of an oscilloscope, a crucial enabling technology for electronic television. John Fleming invented the first radio tube, the diode, in 1904. Two years later, Robert von Lieben and Lee De Forest independently developed the amplifier tube, called the triode.

9 In 1920, Albert Hull developed the magnetron which would eventually lead to the development of the microwave oven in 1946 by Percy Spencer. In 1934, the British military began to make strides toward radar (which also uses the magnetron) under the direction of Dr. Wimperis, culminating in the operation of the first radar station at Bawdsey in August 1936.

10 In 1941, Konrad Zuse presented the Z3, the world's first fully functional and programmable computer using electromechanical parts. In 1943, Tommy Flowers designed and built the Colossus, the world's first fully functional, electronic, digital and programmable computer. In 1946, the ENIAC (Electronic Numerical Integrator and Computer) of John Presper Eckert and John Mauchly followed, beginning the computing era. The arithmetic performance of these machines allowed engineers to develop completely new technologies and achieve new objectives, including the Apollo program which culminated in landing astronauts on the Moon.

cathode *n.* 负极
enabling technology 促成技术

11 The invention of the transistor in late 1947 by William B. Shockley, John Bardeen, and Walter Brattain of the Bell Telephone Laboratories opened the door for more compact devices and led to the development of the integrated circuit in 1958 by Jack Kilby and independently in 1959 by Robert Noyce. Starting in 1968, Ted Hoff and a team at the Intel Corporation invented the first commercial microprocessor, which foreshadowed the personal computer. The Intel 4004 was a four-bit processor released in 1971, but in 1973 the Intel 8080, an eight-bit processor, made the first personal computer, the Altair 8800, possible.

Unit 1

Landscape architects and landscape architecture

In this unit, you will learn:

- **Subject-related knowledge:** The mission of a landscape architect
  The conceptual definition of landscape architecture
- **Academic skill:** Searching for information
- **Reading strategy:** Dealing with unknown words (Part I)

Section A

Pre-reading

1 The following are pictures of some landscape architecture. Match the words and expressions below with the pictures.

1. **streetscape** 2. **waterfront**
3. **arboretum** 4. **wetland**
5. **wildlife refuge**
6. **residential neighborhood**

2 Work in pairs and discuss the questions.

1. According to the knowledge you have learned, what do landscape architects design and plan?
2. How do landscape architects do their projects?

1 Landscape architecture encompasses the analysis, planning, design, management, and stewardship of the natural and built environments. Landscape architecture includes both iconic and neighborhood places, such as local parks, residential communities, commercial developments, downtown streetscapes, and more.

2 Landscape architects have advanced education and professional training. They plan and design traditional places such as parks, residential developments, campuses, therapeutic gardens, arboreta, wildlife refuges, cemeteries, commercial centers, resorts, transportation corridors, corporate and institutional centers, and waterfront developments. They are also becoming involved with environmental remediation. For example, they plan and design the preservation and restoration of natural places disturbed by humans, such as wetlands, stream corridors, and forested land, as well as the reclamation of degraded land, such as mines or landfills. Historic landscape preservation and restoration is another important area where landscape architects are playing an increasingly important role.

3 Working with architects, city planners, civil engineers, and other professionals, landscape architects play an important

Landscape architects

Text A

role in environmental protection by designing and implementing projects that respect the needs both of people and of our environment. Professionals who can meet human needs by making wise use of our environmental resources are in demand today and will continue to be so in the future.

4 A wide range of opportunities are open to landscape architects today. They may work in regional planning and resource management; feasibility, environmental impact, and cost studies; or site construction. Some may work on a variety of projects, while some specialize in a particular area.

5 Landscape architects also may work for many types of organizations – from real estate development firms starting new projects to municipalities constructing airports or parks – and they often are involved with the development of a site from its conception. Working with architects, surveyors, and engineers, landscape architects help determine the best arrangement of roads and buildings. They also collaborate with environmental scientists, foresters, and other professionals to find the best way to conserve or restore natural resources. Once these decisions are made, landscape architects create detailed plans indicating new topography, vegetation, walkways, and other landscaping details, such as fountains and other decorative features.

6 In planning a site, landscape architects first consider the nature and purpose of the project and the funds available. They analyze the natural elements of the site, such as the climate, soil, slope of the land, and vegetation; observe where sunlight falls on the site at different times of the day and examine the site from various angles; and assess the effect of existing buildings, roads, walkways, drainage, and other utilities in the project.

7 Landscape architects prepare a preliminary design after studying and analyzing the site, and taking into account the local, state or federal regulations, such

as those providing barrier-free accessibility and those protecting wetlands or historic resources. To accommodate the needs of the client and other stakeholders in the project, as well as the changing conditions at the site, the design frequently evolves based on input gathered at meetings held during the design development phase. These modifications to the preliminary design contribute to the approval of the final design.

8 In preparing designs, computer-aided design (CAD) has become an essential tool for most landscape architects. Many landscape architects also use video simulation to help clients envision the proposed ideas and plans. For larger-scale site planning, landscape architects also use the geographic information system (GIS) technology, a computer mapping system.

9 Throughout all phases of the planning and design, landscape architects consult with other professionals involved in the project. Once the design is complete, they prepare a proposal for the client. They produce detailed plans of the site, including written reports, sketches, models, photographs, land-use studies, and cost estimates, and submit them for approval by the client and regulatory agencies. When the plans are approved, landscape architects prepare working drawings showing all existing and proposed features. They also outline in detail the methods of construction, itemize construction details, and draw up a list of necessary materials, including the written technical specifications for the project. Finally, during the construction implementation phase of the project, the landscape architects are often called upon, by the client, to monitor the installation of their design.

10 According to the business quarterly surveys conducted by the American Society of Landscape Architects (ASLA) over these years, before the 2008 Crash, landscape architecture firms are growing in size; billing rates are increasing dramatically; and the client base for the profession continues to expand, most significantly in the public sector. The severe economic conditions, however, has made negative impacts on landscape architecture profession: There are modest decreases in work and increases in hiring after 2008. In recent years, although the economic outlook still remains mixed for landscape architecture firms, a steadier future hiring picture has emerged for the this profession with firm

leaders reporting higher levels of billable hours, hiring and especially inquiries for new work – suggesting that the spring thaw could also apply to an industry hit hard by the lack of new design and construction projects over the past years.

11 Based on the projections by the U.S. Bureau of Labor Statistics, employment of landscape architects is expected to grow 5% from 2014 to 2024, about as fast as the average for all occupations. New construction is increasingly dependent upon compliance with environmental regulations, land-use zoning, and water restrictions, spurring demand for landscape architects to help plan sites and integrate man-made structures with the natural environment in the least disruptive way. Landscape architects are also becoming increasingly involved in preserving and restoring wetlands and other environmentally sensitive sites. Due to growth and geographic shifts in population, the expertise of landscape architects will be highly sought after in the planning and development of new residential, commercial, and other types of construction. For the general public, their most important issues and concerns impacting their daily lives and routines have a close relationship to a landscape architects' area of practice and responsibility. Thus, the work of landscape architects will play an increasingly important role in shaping the world's future by making a positive impact on health, economic, social, and environmental issues.

New words and expressions

encompass /ɪn'kʌmpəs/ *vt.*
to include or comprise sth. 包含

stewardship /'stjʊədʃɪp/ *n.*
the way in which sb. organizes and looks after sth. 管理方式

therapeutic /ˌθerə'pjuːtɪk/ *adj.*
helping to treat or cure illness 有助治疗的；有疗效的

arboretum /ˌɑːbə'riːtəm/ *n.* (*pl.* arboreta)
a place where trees are grown so that they can be studied （供研究用的）植物园

corporate /'kɔːpərət/ *adj.*
belonging or relating to a corporation 公司的

institutional /ˌɪnstɪ'tjuːʃənəl/ *adj.*
from or within a large organization 大机构的；大集团的

remediation /rɪˌmiːdɪ'eɪʃən/ *n.*
the process of improving a situation or correcting a problem 补救；纠正

reclamation /ˌreklə'meɪʃən/ *n.*
the process of making an area of land suitable for cultivation, e.g. by draining or irrigating it 开垦；开拓

degrade /dɪ'greɪd/ *vt.*
to make a situation or the condition of sth. worse 使（局面或情况）恶化

landfill /'lændfɪl/ *n.*
a place where waste is buried under the ground 废弃物填埋场

municipality /mjuːˌnɪsɪ'pælətɪ/ *n.*
town, city or district with its own local government 市政当局；自治区

surveyor /sə'veɪə(r)/ *n.*
a person who measures land in order to find borders or to decide where buildings will go （测定地界或为建筑物选址的）检测员

forester /'fɒrɪstə(r)/ *n.*
a person who works in a forest taking care of, planting, and cutting down trees 林务员；林务官

topography /tə'pɒgrəfɪ/ *n.*
the shape of an area of land, including its hills, valleys, etc. 地形；地貌

vegetation /ˌvedʒɪ'teɪʃən/ *n.*
plants in genera, esp. in one particular area （尤指某一地区的）植物，草木（总称）

drainage /'dreɪnɪdʒ/ *n.*
a system of pipes and passages that take away water or waste liquid from an area 排水系统；排水管道

preliminary /prɪ'lɪmɪnərɪ/ *adj.*
happening before sth. that is more important, often in order to prepare for it 初步的；预备的

stakeholder /'steɪkˌhəʊldə(r)/ *n.*
a person who has an interest in the success of a plan, system, or organization, for example a worker in a company or the parent of a child at a school 利益相关者

envision /ɪn'vɪʒən/ *vt.*
to imagine, conceive of, see in one's mind 想象；展望

sketch /sketʃ/ *n.*
a rough quickly-made drawing, without many details 草图；速写

itemize /'aɪtəmaɪz/ *vt.*
to give or write every item of sth. 逐项记载；详细登载；详细列举

specification /ˌspesɪfɪ'keɪʃən/ *n.*
an exact measurement or detailed plan about how sth. is to be made 规格；详细计划书

thaw /θɔː/ *v.*
if ice or snow thaws or sth. thaws it, it becomes warmer and changes into liquid （使）融化；（使）解冻

disruptive /dɪs'rʌptɪv/ *adj.*
causing difficulties that interrupt sth, or prevent it from continuing 扰乱的；制造混乱的

expertise /ˌekspɜː'tiːz/ *n.*
expert knowledge or skill, esp. in a particular field 技能；专业知识

landscape architecture 风景园林；景观设计

therapeutic garden 康体治疗花园

transportation corridor 交通通道

stream corridor 河流廊道

wildlife refuge 野生动植物保护区

design development phase 技术设计阶段

barrier-free accessibility 无障碍通行

computer-aided design (CAD)
计算机辅助设计

geographic information system (GIS)
地理信息系统

regulatory agency 管理机构

construction details 施工详图

technical specification 技术规范

site construction 场地施工

land-use zoning 土地用途分区规划

Reading comprehension

The following table presents you with an overview of Text A. Complete the table based on the information from the text.

Part	Section	Para. and main idea
I	Introduction	1
II	What do landscape architects do?	2
		3 Landscape architects play an important role in environmental protection.
		4
	How do they fulfill their duties?	5
		6
		7 Prepare a preliminary design.
		8
		9
III	Conclusion	10 The current trend in landscape architecture profession in the U.S.
		11

Language focus

1 Specialized vocabulary consists of the words and phrases used regularly in a given subject area. Match the specialized words in Column A with their definitions in Column B.

Column A	Column B
___ 1. arboretum	A. a place where a lot of people spend their holidays
___ 2. vegetation	B. a large deep hole in which very large amounts of rubbish are buried
___ 3. topography	C. a system or process by which water or other liquids are drained from a place
___ 4. architecture	D. an art of planning, designing, and constructing buildings
___ 5. drainage	E. an urban district having its own local government
___ 6. resort	F. a person whose job is to look after a forest, and to cut down and plant trees
___ 7. landfill	G. a facility where trees and shrubs are cultivated for scientific study
___ 8. municipality	H. an ornamental feature in a pool or lake which consists of a long narrow stream of water that is forced up into the air by a pump
___ 9. forester	I. the total mass of plant life that occupies a given area
___ 10. fountain	J. the features of a particular area of land

2 Fill in the blanks with the words given above. Change the form if necessary.

1. To follow the new trend of thought, these designers are striving to turn the _____ into an outdoor eco-lab.
2. Chilly outside, tourists found it amazing that the inn had a garden of semi-tropical _____.
3. Experts can combine pictures taken from airplanes and satellites with _____ data.
4. Today's complex artificial landscape requires close teamwork between the _____ and the designers.
5. The _____ system here, including a water-closet, is of the most complete and modern kind.

6. The town was a seaside _____ in the North-east of England, which has been over-exploited these years.
7. Environmentalists protested against the current plan because they say there is a high risk of pollution from the _____ site.
8. As response to the public, the new _____ authorities have kept the landscape up well.
9. Dutch design always seems to be one step ahead of convention, setting new directions in design and _____.
10. Urban designers made the streets an amazing maze, opening up into surprising, sunny _____ squares.

3 Replace the underlined words and expressions with the words in Text A.

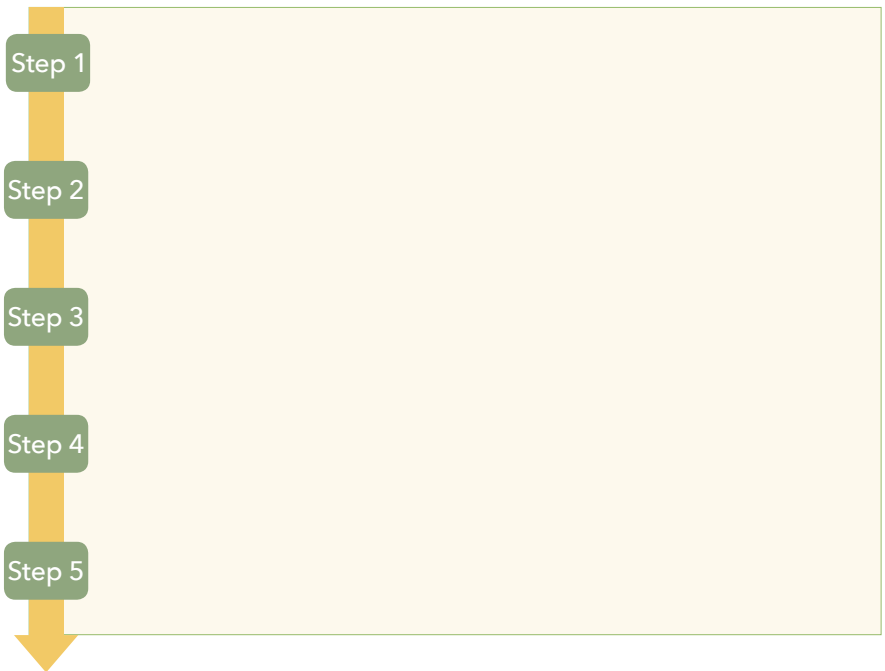
1. Conservationists are concerned over the effect of commercial exploitation of forests. _____
2. Side-slope greening is an important measure to guarantee ecological improvement and soil erosion prevention for artificial side-slope. _____
3. An obvious effect can be achieved during a short period in restoring the degenerated land and in regenerating the ecology affected by artificial factors. _____
4. Farmland expanding and vegetation renovation were two major trends of land use pattern change. _____
5. Functional principles provide guidance on creating landscape designs that fulfill the need of the customer. _____
6. A qualified landscape proposal must encompass a detailed description of design criteria. _____

4 Translate the following paragraph into English.

风景园林设计是对户外公共区域、地标和建筑进行的设计。在设计中要对景观中现有的社会、生态和土壤条件等进行系统调查并实行一些干预措施，以实现环境、社会行为（social-behavioral）及审美的融合，并确保所有的设计计划符合所在国家及地方的建筑规范（building codes）和条例（ordinances）。该领域包括景观设计、场地规划、雨水管理、环境恢复、公园和游憩区域规划、视觉资源管理、绿色基础设施的规划和提供、私人住宅和住宅景观总体规划和设计等。风景园林行业的从业者被称为风景园林设计师。

Critical thinking

1 Please summarize the working procedure of landscape architects according to Text A.



2 During the procedure, as a future landscape architect, what qualities should you have to make you a qualified one? Share your ideas with your partner.

Professional qualities: _____

_____

_____

Social abilities: _____

_____

_____

Research task

Academic skill: Searching for information

Information can come from virtually anywhere – media, blogs, personal experiences, books, journal and magazine articles, expert opinions, encyclopedias, and web pages, etc.

1. Types of information

Type	Use
Magazine	• To find information or opinions about popular culture. • To find up-to-date information about current events. • To find non-scholarly articles about topics of interest within the subject of the magazine.
Academic journal	• To get help for your scholarly research. • To find out what has been studied on your topic. • To find bibliographies that point to other relevant research.
Database	• To find articles on specific topics. • To find online journals or news articles.
Newspaper	• To find editorials, commentaries, expert or popular opinions. • To find current local, national or world news.
Library catalog	• To find virtually any topic. • To find hard copies of current or back issue of journals, books, newspapers or magazines.
Website	• To find information from all levels of government – central to local. • To find expert or popular opinions. • To find information of various types of media, e.g. illustrations, audio and video information.

2. Searching for information

Author / Title search

Searching by author and / or title obviously assumes that you are searching for a particular author, book or article, probably in either a database or a library catalog. Here are some tips:

- When searching by author, put the author's last name first, e.g. "Kotler, Philip", not "Philip Kotler", if he is from an English-speaking country. Search the author's full name in Chinese order if he is a Chinese. Sometimes, the

author could be an organization, so give the full name of the organization as it commonly appears, e.g. "World Bank".

- When searching by title, it helps if you enter the title as correctly as possible.

Keyword search

It is basically a way of searching through subject or topic. Most library catalogs and databases will include an option to search by keyword as an alternative to author and title. The first step of keyword search is to decide the key word(s) or phrase(s). Normally, the word(s) or phrase(s) which can cover the topic you search can be selected as keyword(s). A good research topic usually contains two or three concepts. For example, you need to write a paper on "The Impact of Cognitive Styles on Design Students' Spatial Knowledge". We can break the topic into concepts, like "cognitive styles" and "spatial knowledge", which can be used as keywords. Then type them in a search bar in a database, EBSCOhost for instance. In a database, there are usually two ways of search, i.e., basic search and advanced search.

Basic search (see Fig. 1) generates a large number of sources for you to differentiate, which is an exhausting task. But advanced search (see Fig. 2), which provides more choices for further conditioning, can make the work lighter. There are many variables that can be chosen to refine the search. And you can define the relationship between the keywords by choosing "and", "or" or "not" based on the results you intend to obtain.

Fig. 1 Basic search

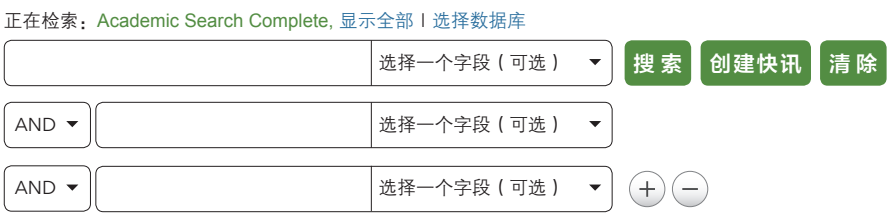


Fig. 2 Advanced search

As "cognitive styles" is a broader topic and "spatial knowledge" is more specific, they can be typed in the upper and middle search bars respectively. More relevant results will appear. You can then refine the search by selecting a specific variable. In

this case, "subject" (主题语) can be chosen to filter the results (See Fig. 3).

Fig. 3

Snowball search

It is a good way if your topic has a key work or author. You can trace the citations of that author using a specialized citation database, such as the Social Science Citation Index to obtain other key works or authors. You will follow the stream of research up to the near present and see the way in which the work or the author has influenced the subsequent studies.

3. Evaluating information

Once you have found information that satisfies the requirements of your research, you should evaluate it. Evaluating information encourages you to think critically about the reliability, validity, accuracy, authority, timeliness, point of view or bias of information.

When evaluating information, you can use the five criteria AAOCC, namely, Authority, Accuracy, Objectivity, Currency and Coverage. They can be applied to check all information.

1) Authority of information
   - Who published it?
   - What institution published it?
   - Does the publisher list his or her qualifications?
2) Accuracy of information
   - Who provided it, and can you contact him or her?
   - Does it provide enough details?
   - Has it been cited correctly?

3) Objectivity of information
   - What is the purpose of it, or why was it published?
   - Is it biased?
   - What opinions (if any) are expressed by the author?
4) Currency of information
   - When was it published?
   - When was it updated?
   - How up-to-date is it?
5) Coverage of information
   - Do citations in it complement the research?
   - Is it all text or a balance of text and image?
   - Is it free or is there a fee to obtain it?

Task

Now you know what landscape architecture is and what a landscape architect does. Please work in groups and search for information on some classic cases of landscape architecture according to the three missions of a landscape architect. You can refer to the following table and write down what you have found and where you found the information.

The mission of a landscape architect	Classic case of landscape architecture			Where did you find the information?
	Architect	Date	Feature	
They plan and design traditional places such as parks, residential developments, campuses, gardens, etc.				
They plan and design the preservation and restoration of natural places disturbed by humans, such as wetlands, stream corridors, and forested land.				
They are playing an increasingly important role in historic landscape preservation and restoration.				

Section B

Reading strategies

Dealing with unknown words (Part I)

The ability to deal with unknown words is a key reading skill in the reading process. It is a vital skill because you are almost certain to find unknown or unfamiliar words in any text. The skill is not necessarily to "know" the words, but to guess the meaning of them so that you can read and understand the whole text. Here are several different ways that can help you guess the meaning of an unknown word.

Guessing by example

Sometimes you may find an example which often follows the signal words "for example" "such as", etc. around the unfamiliar word. The example often provides more details that can help you infer the meaning of the unfamiliar word. For example:

> *They are also becoming involved with environmental remediation. For example, they plan and design the preservation and restoration of natural places disturbed by humans, …*

Here you should understand that "remediation" is an act of correcting an error or a fault or an evil by reading the following "For example ..." sentence, which explains the meaning of the word by a real case.

Guessing by synonyms and antonyms

This is a very useful skill to learn. What you should do here is look at other words which relate to that word and work out what it may mean. These words may be either synonyms (words with a similar meaning) or antonyms (words with an opposite meaning). For example:

> *… they plan and design the preservation and restoration of natural places disturbed by humans, such as wetlands, stream corridors, and forested land, as well as the reclamation of degraded land, such as mines or landfills.*

Here you can work out the meaning of "restoration" by its synonym "preservation". All you need to do is to read the rest part of the sentence and think of the meaning of it.

Sometimes, when you come across an unknown word, besides guessing it, you can also ignore the word, especially when the word starts with a capital letter or is in italics, which means that it is in all probability a proper name or a loanword. In this case, you should waste no time in trying to understand the exact meaning of the word. For example:

> *Based on the projections by the U.S. Bureau of Labor Statistics, employment of landscape architects is expected to grow 5% from 2014 to 2024, about as fast as the average for all occupations.*

Here the word "bureau" is a word that you should learn to ignore because it starts with a capital letter and is therefore a word may not influence the overall meaning of the sentence.

Task

Read Text B and apply the skills above to deal with the underlined words.

Text B

The conceptual definition of landscape architecture

1 To bring us closer to a meaningful definition of landscape architecture for today, let us look briefly at some earlier concepts. The Hubbards refer to landscape architecture as primarily a fine art whose most important function is to create and preserve beauty in the surroundings of human habitations and in the broader natural scenery of the country; but it is also concerned with promoting the comfort, convenience and health of urban populations, which have scanty access to rural scenery, and urgently need to have their hurrying, workday lives refreshed and calmed by the beautiful and reposeful sights and sounds which nature, aided by the landscape art, can abundantly provide. This definition reflects Frederick Law Olmsted's belief that the contact with natural landscape was essential for human morality, health, and happiness.

2 Garrett Eckbo defines landscape architecture as covering that portion of the landscape which is developed or shaped by man, beyond buildings, roads, or utilities and up to wild nature, designed primarily as space for human living (not including agriculture or forestry). It is the establishment of relations between building, surfacing, and other outdoor construction, earth, rock forms, bodies of water, plants and open space, and the general form and character of the landscape; but the primary emphasis is on the human content, the relationship between people and landscape, between human beings and three-dimensional outdoor space quantitatively and qualitatively.

3 This definition is essentially concerned with site planning and the relations between people and the design in that context. Thus it is more limited in scope than that of the Hubbards.

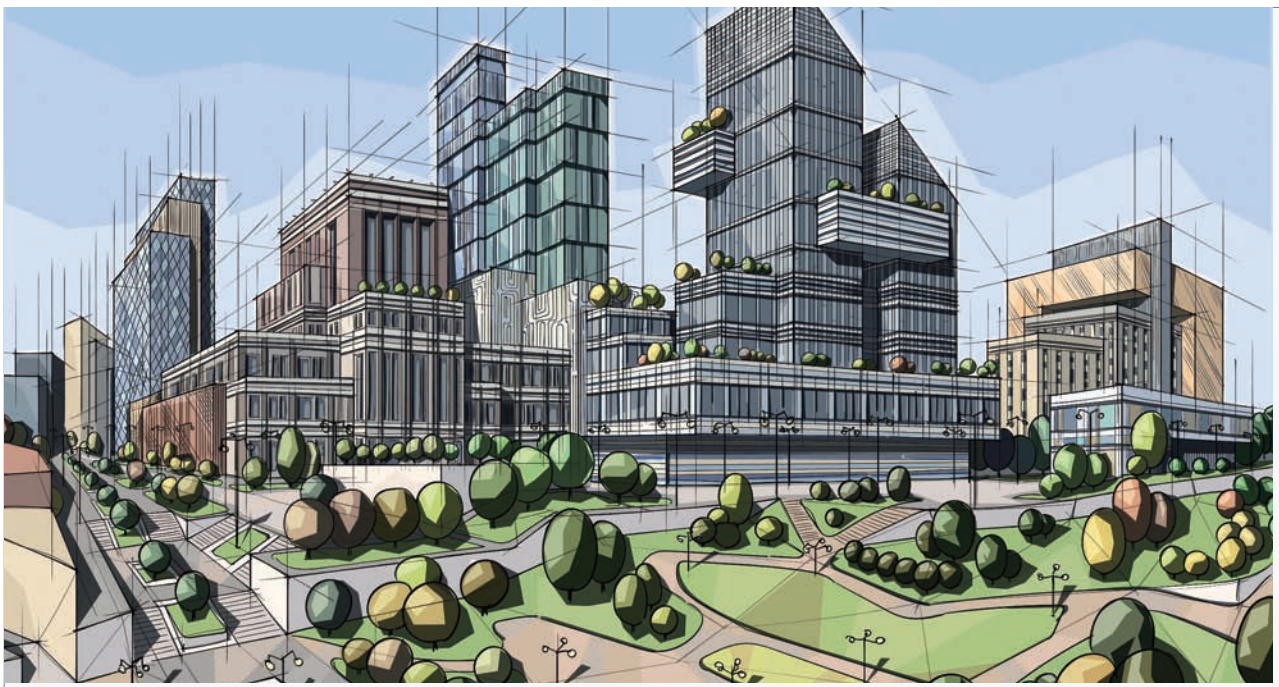
4 Eckbo's definition is related to the concept expressed by others that landscape architecture is an extension of architecture by other means. They are regarded as the same job. It is argued that until about the end of the 18th century no architect would

have considered himself incapable of designing the space between buildings or the space around buildings, that is, gardens and landscape. The people we think of as the great landscapists of the 18th century thought of themselves as architects as much as gardeners; for example, in England, Lancelot Brown, called Capability Brown, renowned for his landscape gardens, also designed houses, although the quality of the houses is not thought to be too high. Conversely, some of the people we think of as great architects of 18th-century England, like William Kent, were also great landscape architects, and Kent saw no incompatibility between the two pursuits. Chiswick House and Gardens, which Kent designed, illustrate his skill at both. According to this theory, the differences between architecture and landscape architecture occur in the means, techniques, and materials, not in the basic objectives.

5 Herein lies a parallel with Urban Design. As an architect, Brown had a greater control over the setting, and form of buildings in his landscapes. The urban designer is concerned with the space between buildings in an urban context and also needs to know about both architecture and landscape.

6 More recently Elizabeth Kassler points out that the ancient gardens of China and Japan were expensive pieces of real estates but they were also consciously constructed and aesthetically perceived artefacts; whereas in the West, landscape design has frequently been considered as a form of architecture. Kassler challenges the concept that landscape is a form of architecture and suggests that landscape architecture would do better to draw its determinants of form from scientific knowledge and research in ecology and behavioral studies as well as from painting, sculpture, and architecture. She thus identifies broader responsibilities for the landscape architect to see beyond the boundaries of his design project and to become involved with and understand the larger region in which his project lies, where the impact of numerous projects and developments represents another level of concern for him.

7 It can be seen that the definition of the profession has varied over the years in an attempt to match its goals with the problems and needs of society. Recently the American Society of Landscape Architects amended its official definition to include “the stewardship of the land” as one of its commitments.



8 The point becomes clear, however, that no one philosophical position is appropriate for a profession whose work occurs in both the countryside and the city. Neither art, ecology, sociology, architecture, nor horticulture alone can provide an adequate basis for a responsible landscape design. The relevance that each might have in any situation depends on the nature of the project and the context.

9 Professionals frequently find it frustrating that their role in society has been consistently misunderstood. Landscape gardening is the usual interpretation, but the terms "site planning", "urban design", and "environmental planning" are frequently added to the names of landscape architectural firms as a means of expressing their broader concerns and capabilities.

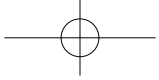
10 Frederick Law Olmsted, designer of New York City's Central Park with Calvert Vaux, coined the term "landscape architect" in 1858. Olmsted was a prolific man and in addition to city parks he also planned complete urban open space systems, city and traffic patterns, subdivisions, university campuses, and private estates. In addition, he was active in the conservation movement and in 1865 was largely responsible for the first area of scenic landscape, Yosemite Valley in California, being set aside for public

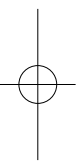
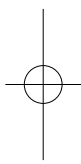
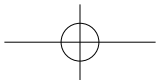
use and enjoyment. All this he called "landscape architecture", so it is not surprising that there has been some confusion about what landscape architects do. Olmsted had no training in the profession which he established at the age of 40, but his ability in writing and management, and his romantic disposition fitted him for the role he adopted. The American Society of Landscape Architects was founded in 1899 by 11 practitioners, most of whom were associated with Olmsted. Others, such as Horace Cleveland and Charles Eliot, followed in his footsteps and in 1901 the first complete program in landscape architecture was established at Harvard University.

11 After these auspicious beginnings the prestige of the profession waxed and waned. Landscape architects found themselves in competition with other environmentalists of the 19th century: engineers, surveyors, foresters, park superintendents, and city planners. In fact, the city planning profession emerged out of landscape architecture in 1907 in America.

12 Thus from being responsible for some very large and important works in the 19th century, the landscape profession entered a somewhat less ambitious phase in the early 1900s with greater emphasis on large estates, gardens, and small scale site planning. However, during the depression years of the 1930s, landscape architects became involved again in larger scale projects, playing a significant role in the various public works programs, particularly those of the U.S. National Parks Service. Since World War II, the work of landscape architects, often operated by members of a team, has changed to include the restoration of derelict land, regional landscape analysis and planning, urban design and site planning for housing, schools, and large scale industrial plants. These now form a major portion of the landscape architecture carried on in public agencies and private practice.

13 It should also be remembered that landscape work, unlike architecture, does not always have an immediately perceptible impact and the effectiveness of planting and land-use decisions or policies may not be appreciable for 20 to 30 years. For example, the landscape of the first new towns in England is just beginning to achieve the effect and visual qualities that were in the minds of the designers 25 years ago, and the housing built during wartime in the United States has often been demolished, leaving mature trees for a replacement projects. This fourth dimension, time, is an important aspect of landscape architecture.

Unit 1

Tree identification and measurement

In this unit, you will learn:

- **Subject-related knowledge:** Tree identification
  Measurement of tree diameter
- **Academic skill:** Collecting data
- **Reading strategy:** Dealing with unknown words (Part I)

Section A

Pre-reading

1 Tree identification is of great importance in the knowledge of dendrology (树木学) and the study of each organ in trees is reliable in tree identification. Fill in the blanks in the following pictures with the given words below.

seeds **maple leaves** **sepal** (萼片)
ginkgo leaves (银杏叶) **petal** (花瓣)
bark (树皮) **twig** (枝条)

a. _____ b. _____

c. _____ d. _____

e. _____

f. _____ g. _____

2 Disscuss the following questions in groups.

1. Make a list of at least five organs in a plant.
2. Different organs have different functions. Give an introduction to one specific organ in a plant, including its name, functions and form.

1 Trees are classified into groups primarily by their fruits and flowers, but the leaves and twigs are usually more accessible for identification. Tree identification in urban locations requires knowing many trees because of the numerous exotics that have been introduced from around the country and the world. The most important features to look for in identifying a tree are: leaves, twigs and stems, bark, flowers, fruits and seeds, cones.

Leaves

2 One way to identify a tree is by its leaves. Leaves have many distinguishing characteristics and these characteristics can be used for identification. The following aspects of leaves have features used for identifying a tree. They are: part, type, shape, arrangement on the stem, venation, shape of apex and base, margin, and surface.

Tree identification

Text A

Twigs and stems

3 Twigs are useful in identifying trees except for a short period during the spring when the buds are opening and shoots are elongating on these small branches. Several features of twigs, including buds, leaf scars, lenticels, pith, spurs, thorns, spines, and prickles, can help describe them. Other factors to consider are color, taste, and odor. The color of the bark can be a most important feature on young stems.

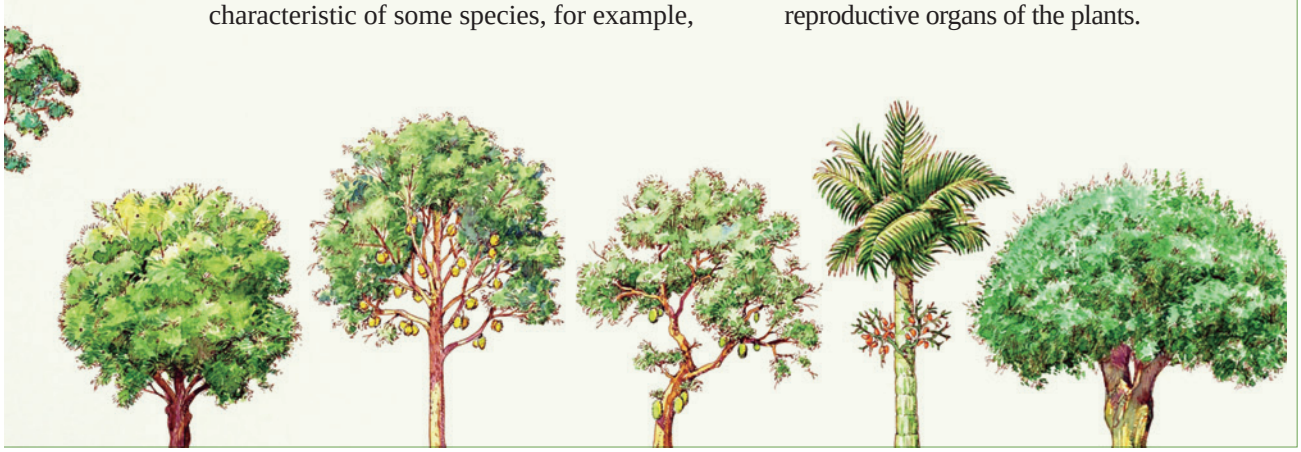
Bark

4 Bark is one of the most important features for tree identification because of its year-round accessibility. It is especially useful when the tree leaves and twigs are inaccessible or unavailable during the fall and winter. The shape of the bark is characteristic of some species, for example, the small, rectangular plates on flowering dogwood. Bark on young trees differs from that on more mature trees. Experience is the best way to learn bark characteristics.

Flowers

5 Flowers are the best feature for identifying trees, but are available only for a short period each year. Leaves, twigs, and bark are usually available for identification, but if there is doubt about a certain tree, the flower is the surest way to identify it.

6 Although not always noticeable to the casual observer, all hardwoods bear flowers. Some produce flowers annually, while others flower less often. Flowers are modified leaves that have undergone change to the point that they have become or support the reproductive organs of the plants.



Complete and incomplete flowers

7 A complete flower has four parts: sepals, petals, stamens, and pistils. An incomplete flower is one that lacks any of these parts.

Perfect and imperfect flowers

8 A perfect flower includes actively functioning organs of both sexes but may lack sepals or petals. The stamen is the male reproductive structure, and the pistil is the female reproductive structure. A perfect flower may be either complete or incomplete.

9 A flower lacking either functional stamens or pistils is imperfect. These flowers may also be known as unisexual flowers, meaning they are either pistillate (female) or staminate (male). These may occur on the same tree, or the male and female parts may be on separate trees, as in the ginkgo.

Arrangement of flower blooms

10 Flowers bloom in different arrangements. Individual or single bloom flowers are typical of many woody plants, for example the magnolia.

11 A cluster or an inflorescence is a collection of individual flowers arranged in a specific pattern. One that blooms at the end of a central stalk, or rachis, is referred to as a determinate flower. The dogwood tree has a determinate flower. If the flowers open progressively from the base to the apex or from the outside to the center in flat-topped clusters, the flower is indeterminate. The flowering crab apple has an indeterminate flower.

12 A flower at the end of a twig is a terminal flower. An inflorescence that appears in a leaf axil, or bud, is described as axillary. Flowers may also appear from separate flower buds, which are normally located near the tips of the twigs.

Fruits and seeds

13 Another key to identifying a hardwood is its fruit or seed. A fruit is the seed-bearing organ of the plant. Using fruit is somewhat limited, however, because some trees do not bear fruit and others do so only for a short time or at irregular intervals. Fruits develop from flowers. Solitary flowers that have a single pistil produce a single fruit. A cluster of flowers with multiple pistils produces a cluster of fruit or a compound fruit. Some fruits have only one seed, and others develop many seeds. In most species, pollination and fertilization must occur for fruit to develop. Fruit development can take from a week or two in elms to two growing seasons in red oaks.

Simple fruits

14 Simple fruits develop in various forms. There are two basic types, dry and fleshy, each of which has a wide range of variations.

15 The two primary forms of dry fruit are indehiscent, meaning not split open at maturity, and dehiscent, meaning split open when ripe. Indehiscent fruits are usually one-seeded with the seed enclosed in various types of coverings. Species with this type of fruit include maples and oaks. Dehiscent fruits are usually many-seeded and are enclosed in a covering that splits when the fruit is ripe, such as the redbud, magnolia, and rhododendron.

16 Fleshy fruits are usually multi-seeded; the seeds are surrounded by a fleshy pulp, or pericarp, which is sometimes edible. These may be classified as a berry (blueberry and persimmon), drupe (cherry, plum, and holly), or pome (apple or pear).

Compound fruits

17 Fruits that develop from multiple pistils are called compound. Two types of compound fruit are aggregate and multiple.

18 Aggregate fruits develop from a single flower that has many pistils that form many fruitlets in a single mass, such as the magnolia or tulip tree.

19 When several flowers together contribute to the development of a single fruit, it is called a multiple fruit. The fig tree and the mulberry produce examples of this type of fruit.

Cones

20 Seeds for softwoods (conifers) are found in cones. Most conifers are monoecious. Monoecious means that both male and female reproductive parts are located in separate structures on the same tree. A few conifers are dioecious: The male and female reproductive parts are on separate trees. Male and female structures are called cones or strobile. Cones consist of an egg or pollen-bearing scales attached to the central stem. The scales may be arranged spirally or they may appear in pairs.

New words and expressions

exotic /ɪg'zɒtɪk/ *n.* 外来植物；外来树种

stem /stem/ *n.* 茎

cone /kəʊn/ *n.*（松树、冷杉树等的）球果

venation /viː'neɪʃən/ *n.*
the system or pattern of the veins in a leaf 叶脉

apex /'eɪpeks/ *n.*
the highest point (of sth.) 顶点；尖端

elongate /'iːlɒŋgeɪt/ *vi.*
to become longer 伸长

lenticel /'lentɪsel/ *n.* 皮孔

pith /pɪθ/ *n.*
a soft white substance that fills the stems of some plants（某些植物茎中的）髓

spur /spɜː(r)/ *n.*
a short fruit-bearing tree branch（枝）距

spine /spaɪn/ *n.*
a long, sharp point on a plant 刺

prickle /'prɪkl/ *n.*
a sharp pointed part on a plant（植物的）刺，棘

rectangular /rek'tæŋgjʊlə(r)/ *adj.*
having four right angles 矩形的

dogwood /'dɒgwʊd/ *n.*
山茱萸科；木属植物

hardwood /'hɑːdwʊd/ *n.*
a tree that takes a long time to grow and that produces strong heavy wood 硬木树；阔叶树

incomplete flower 不完全花

complete flower 完全花

imperfect flower 单性花

perfect flower 两性花

stamen /'steɪmen/ *n.*
the male reproductive organ of a flower（花的）雄蕊

pistil /'pɪstɪl/ *n.*
the female seed-producing part of a flower（花的）雌蕊

pistillate /'pɪstɪlɪt/ *adj.* 只有雌蕊的

staminate /'stæmɪnɪt/ *adj.* 只有雄蕊的

woody plant 木本植物

magnolia /mæg'nəʊlɪə/ *n.*
a tree with large white, yellow, or pink flowers 木兰树

inflorescence /ˌɪnflɔː'resəns/ *n.*
a cluster of flowers 花；花序

rachis /'reɪkɪs/ *n.* 花序轴；叶轴

determinate /dɪ'tɜːmɪnət/ *adj.*（花序）有限的

crab /kræb/ **apple** *n.*
花红（树）；沙果（树）

terminal flower 顶生花

axillary /æk'sɪlərɪ/ *adj.*
situated in, or rising from an axil; of or pertaining to an axil 叶腋的；腋生的

solitary /'sɒlɪtərɪ/ *adj.*
(of plants and animals) not growing or living in groups or colonies 单生的

single fruit 单果

compound fruit 复果

pollination /ˌpɒlɪ'neɪʃən/ *n.*
the act of causing (a flower or plant) to be able to produce seeds by adding or bringing pollen 授粉（作用）

fertilization /ˌfɜːtɪlaɪ'zeɪʃən/ *n.* 授粉

elm /elm/ *n.* 榆树

oak /əʊk/ *n.* 栎树；橡树

indehiscent /ˌɪndɪ'hɪsənt/ *adj.*
(of fruits) not opening to release seeds（果实等成熟

时）不开裂的

dehiscent /dɪˈhɪsənt/ *adj.*
(of fruits) opening spontaneously to release seeds （果实等成熟时）开裂的

redbud /ˈredbʌd/ *n.* 紫荆

rhododendron /ˌrəʊdəˈdendrən/ *n.* （植物）杜鹃

pulp /pʌlp/ *n.* 果肉

pericarp /ˈperɪkɑːp/ *n.*
the part of a fruit enclosing the seeds 果皮

persimmon /pɜːˈsɪmən/ *n.*
a soft orange-colored fruit that grows in hot countries 柿子

drupe /druːp/ *n.*
any type of fruit with a hard stone surrounded by juicy flesh 核果

plum /plʌm/ *n.* 李子

holly /ˈhɒlɪ/ *n.* 冬青

pome /pəʊm/ *n.*
the fruit produced by trees like apples and pears 梨果

aggregate fruit 聚合果

fruitlet /ˈfruːtlɪt/ *n.* 小果实

tulip tree 北美鹅掌楸

multiple fruit 聚花果

fig tree 无花果树

mulberry /ˈmʌlbərɪ/ *n.* 桑树

softwood /ˈsɒftwʊd/ *n.*
a tree that has soft wood 软木树；针叶树

conifer /ˈkɒnɪfə(r)/ *n.*
a tree that has needle-shaped leaves which it does not normally lose in winter, and produces brown cones that contain its seeds 针叶树

monoecious /mɒˈniːʃəs/ *adj.*
(of some flowering plants) having the male and female reproductive organs in seperate flowers on the same plant 雌雄同株的

dioecious /daɪˈiːʃəs/ *adj.*
(of some plant) having the male and female reproductive organs in seperate flowers on seperate plants 雌雄异体的

strobile /ˈstrəʊbaɪl/ *n.* 球果；孢子叶球

pollen /ˈpɒlən/ *n.*
the fine powder produced by flowers, which makes them produce seeds 花粉

scale /skeɪl/ *n.* 鳞片

spirally /ˈspaɪrəlɪ/ *adv.* 成螺旋形地

Reading comprehension

1 Read Text A and complete the table with the words or expressions in the text.

Feature in tree identification	
Leaves	The features used for identifying trees: part, shape, 1) _____, venation, shape of apex and 2) _____, margin, and surface
Twigs and stems	• The time that twigs cannot be used for tree identification: the short period during the 3) _____ • A most important feature on young stems: 4) _____
Bark	• The reason that bark is one of the most important features for tree identification: 5) _____ • The best way to learn bark characteristics: 6) _____
Flowers	• The surest way to identify a certain tree: the flower
Fruits and seeds	• The characteristic of a fruit: 7) _____ • The production of solitary flowers that have a single pistil: 8) _____ • The production of a cluster of flowers with multiple pistils: 9) _____
Cones	• The findings in cones: 10) _____ • The composition of cones: 11) _____ or 12) _____ attached to the central stem

2 Write down the botanical characteristics of the following plants mentioned in Text A.

Example

flowering crab apple

The flowering crab apple has an indeterminate flower.

1. flowering dogwood _____
2. ginkgo _____
3. red oak _____
4. maple _____
5. rhododendron _____
6. fig tree _____

Language focus

1 **Fill in the blanks with the antonyms of the underlined words based on the information from Text A.**

1. The shape and form of the bark differ not only in the variety of trees but also in age. In other words, the bark on young trees may appear distinctively from that on more _____ trees.
2. The _____ flower lacks either functional stamens or pistils, while the perfect flower contains actively functioning parts of both sexes.
3. The unisexual flowers usually occur in the ginkgo, where the male and _____ parts may grow on separate trees.
4. As one of the primary form of dry fruits, the most difference between dehiscent fruits and _____ fruits is that the former will split open when ripe and are usually many-seeded.
5. Cherry and plum can be classified as _____ fruits. In opposite to dry fruits, their seeds are commonly surrounded by edible and full pulp or pericarp.
6. _____ fruits, including aggregate and multiple, are developed from multiple pistils, which differ from the single fruits in many areas.

2 **Summarize the meanings of the following terms based on the information from Text A and consult a dictionary for their Chinese translations.**

	Meaning	Chinese translation
twig		
unisexual flower		
indeterminate flower		
fleshy fruit		
aggregate fruit		
dioecious		

3 **The following pairs of words are categorized with the same prefixes or word roots. Summarize the meanings of them and write down other examples with the same prefixes or word roots.**

1. A few conifers are **dioecious**: The male and female reproductive parts are on separate trees.

   Studying the light in each image could also reveal physical characteristics, such as the presence of water or carbon **dioxide**.

   ◎ meaning of the prefix:

   _____

   ◎ examples with the same prefix:

   _____

2. Trees are classified into groups primarily by their fruits and flowers, but the leaves and twigs are usually more **accessible** for identification.

   When the chairman of Campbell's retired, McGovern was named as his **successor**.

   ◎ meaning of the word root:

   _____

   ◎ examples with the same word root:

   _____

3. Twigs are useful in identifying trees except for a short period during the spring when the buds are opening and shoots are **elongating** on these small branches.

   The fall in inflation is the silver lining of the **prolonged** recession.

   ◎ meaning of the word root:

   _____

   ◎ examples with the same prefix:

   _____

4. Dehiscent fruits are usually many-seeded and are **enclosed** in a covering that splits when the fruit is ripe, such as the redbud, magnolia, and rhododendron.

   The new students only stand aside while their parents are busy helping them **enroll**.

   ◎ meaning of the prefix:

   _____

   ◎ examples with the same prefix:

   _____

4 Translate the following paragraph into English.

火炬松（loblolly pine），常绿（evergreen）针叶树，自然分布于美国东南部。在美国南部，它是一种具有木材（lumber）和纸浆用材（pulpwood）价值的主要用材树种（timber tree）。常种植于道路两旁、住宅边缘和种植园中。火炬松生长速度中等，在俄亥俄州（Ohio）的开阔地域能生长到50英尺高、30英尺冠幅。其原产地冬季较温暖，在这样的气候条件下，火炬松生长速度较快，在孤植的情况下通常能长到80英尺高、40英尺冠幅。

Critical thinking

1 If the foreign species is not planted but transferred into a new environment, how and when should a tree be moved? Write down a few basic steps with which a tree can be safely moved to another habitat.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____

2 Trees play an important role in our lives and come in many different features, such as shapes, sizes, types of leaves and so on. Botanists pour a great deal of time and energy into assisting people in identifying the various types of trees that exist. Discuss the following questions in groups:

- Is it worth putting efforts into identifying different types of trees? Why or why not?
- What is the importance of tree identification?

3 As is mentioned in Text A, in urban locations there exist numerous exotics that have been introduced from around the country and even the world. Discuss the question in groups: What aspects should be taken into consideration when bringing a foreign species to a new environment?

Research task

Academic skill: Collecting data

Data collection is one of the most important stages in conducting research. Accurate and systematic data collection is critical to conducting scientific research. There are many methods to collect data, depending on the research design and the methodologies employed. Some of the common methods are questionnaire, interview and observation.

1. How to design a questionnaire

A questionnaire is designed for both descriptive and analytical surveys. In a descriptive survey, the questionnaire will normally use nominal and ordinal scales because it concerns primarily with the particular characteristics of a specific subject.

Example of nominal scale:

What is your gender?

☐ Male ☐ Female

What is your hair color?

☐ Brown ☐ Black ☐ Blonde ☐ Gray ☐ Other

Example of ordinal scale:

How do you feel today?

☐ Very unhappy ☐ Unhappy ☐ OK

☐ Happy ☐ Very happy

How satisfied are you with our service?

☐ Very unsatisfied ☐ Somewhat unsatisfied ☐ Neutral

☐ Somewhat satisfied ☐ Very satisfied

Rating scale is always used to measure the attitude or opinion of the respondents in an analytical survey. The most popular one is Likert scale. Usually you would use a 1-5 rating scale where: 1 = strongly disagree; 2 = somewhat disagree; 3 = undecided; 4 = somewhat agree; 5 = strongly agree.

Example of Likert scale – The employment self-esteem scale:

1 I am proud of my relationship with my supervisor at work.

1 2 3 4 5

2 I am confident that I can handle my job without constant assistance.

1 2 3 4 5

3 When I feel uncomfortable at work, I know how to handle it.

1 2 3 4 5

When designing a questionnaire, you have to pay attention to the following issues:

- Are the instructions clear and unambiguous?
- Can the questions be understood, and are they free from jargon, terminology, unsuitable assumption and ambiguity?
- Do the respondents have required knowledge to answer the questions?
- Do the questions appear offensive or embarrassing to the respondents?
- Do the questions lead the respondents to particular answers?

2. How to conduct an interview

Since an interview involves bi-directional communication, there are certain rules and guidelines to be followed:

- Ask one question at a time.
- Attempt to remain as neutral as possible. Don't show strong emotional reactions to the responses of the interviewee.
- Verify understanding through raising and confirming questions.
- Let the interviewee do most of the talking.
- Maintain control over the subject matter.

3. How to conduct observation

There are generally two ways of conducting observation, namely non-participant observation and participant observation. The researcher in non-participant observation does not involve in the subject being studied. Data are collected by observing the behavior or phenomenon. In contrast, the researcher in participant observation immerses into ongoing activities and makes observation records. Data are collected by interacting with or experiencing the phenomenon being studied. Here are some tips for conducting observation:

- The collection of detailed field notes is key to successful observation.
- Audio recorders or cameras can be used to aid with capturing raw data.
- Participant observation researchers should state their intentions openly.
- Non-participant observation researchers should adopt a more separate and distant role than that of the participant observers.
- Non-participant observation can be overt or covert.

Task

In Text A, the author informs us of several methods to identify a tree with explanations and illustrations. Now it is your turn to explore the campus and choose one part of a certain tree which you think is particular enough for identifying tree species. Then use the observation method introduced above to collect data and make a description of the specific part by using the collected information. Discuss your searching results and description with your classmates. Descriptions of three different types of leaves are listed here as models.

The tree bears cones and has leaves that are needle-like.

Features: These trees are called CONIFERS (cone-bearing) and most are EVERGREEN (trees with needles or leaves that remain alive and on the tree through the winter and into the next growing season).

The tree bears cones that are sometimes berry-like and has leaves that hug the twig and are scale-like or awl-shaped.

Features: These trees are called CONIFERS (cone-bearing) and most are EVERGREEN.

The tree has leaves that are flat and thin and generally shed (落叶) annually.

Features: These trees are called BROADLEAF (a tree with leaves that are flat, thin and generally shed annually), and most are DECIDUOUS (shedding all leaves annually) and bear a variety of fruits and flowers.

Section B

Reading strategy

Dealing with unknown words (Part I)

The ability to deal with unknown words is a key reading skill in the reading process. It is a vital skill because you are almost certain to find unknown or unfamiliar words in any text. The skill is not necessarily to "know" the words, but to guess the meaning of them so that you can read and understand the whole text. Here are several different ways that can help you guess the meaning of an unknown word.

Guessing by explanation

Sometimes, you will find that the meaning of an unfamiliar word is given to you in the text. In this case, what you need to do is keep on reading and do not stop at the moment when you find an unfamiliar word. Typically, the way to deal with this word is that you have a phrase in commas immediately after the unfamiliar word:

> *The two primary forms of dry fruit are indehiscent, meaning not split open at maturity, and dehiscent, meaning split open when ripe.*

Here you should understand that "indehiscent" is of dry fruits that do not split open at maturity, and "dehiscent" is of dry fruits that do split open when ripe.

Guessing by synonyms and antonyms

This is a very useful skill to learn. What you should do here is look at other words which relate to that word and work out what it may mean. These words may be either synonyms (words with a similar meaning) or antonyms (words with an opposite meaning). For example:

> *Twigs are useful in identifying trees except for a short period during the spring when the buds are opening and shoots are elongating on these small branches.*

Here you can work out the meaning of "twig" by its synonym "branch". All you need to do is to read the next sentence and think of the meaning of it.

Guessing by examples

Sometimes you may find out examples which often follow the signal words "for example" "such as" etc., or are in brackets around the unfamiliar word. The examples provide more details that can help you infer the meaning of the unfamiliar word. For example:

> *Fleshy fruits are usually multi-seeded; the seeds are surrounded by a fleshy pulp, or pericarp, which is sometimes edible. These may be classified as a berry (blueberry and persimmon), drupe (cherry, plum, and holly), or pome (apple or pear).*

Here the word "pome" can be easily inferred that it may be the term of a fresh fruit like apple or pear.

Task

Read Text B and apply the skills above to deal with the underlined words.

Text B

Measurement of tree diameter

1 Many people are concerned with the adequacy of the use of our forest land and want to make sure it produces a maximum of wood and related services useful in our livelihood. With continuing increase in the value of forest products, more attention is being paid to accurate forest measurement.

2 Measurements play a significant role in the management of a forested area, with the intent to achieve such objectives as the production of more wood, forage, game animals, water, or recreational benefits. Periodic inventories of forested land are required for determining amounts and quality of wood available for yearly use, for tax records, and for justifying management expenditures. The sawtimber, pulp, and plywood industries have become more adept at using various qualities of wood for different products; hence log weighing has become a common practice. In brief, measurement is a strategic part of forest management.

pulp *n.* 纸浆
sawtimber *n.* 锯材

3 The diameter of a tree is most commonly determined at breast height, which is an established reference point (standard taken at 4½ feet <137 cm> above average ground level). The diameter breast height, abbreviated dbh, is taken outside the bark to the nearest 1/10 inch (0.25 cm) when making volume-growth determination, and to the nearest 2 inches (5 cm) when estimating total volume of a stand, which is a close-enough measurement in that case. In instances of abnormal growth shapes, leaning trees, and trees growing on slopes, adjustments are made in measuring diameters to avoid any unusual influence on the measurement.

4 In measuring tree diameters the basic instruments are referred to as dendrometers. The three most common ones are the diameter tape, the tree caliper, and the Biltmore stick. The instrument selected for use usually depends upon the degree of closeness of measurement desired, the convenience of the use of the instrument, and the place on the tree to be measured.

5 Trees are not perfect cylinders. The diameter of most trees is greater in one direction than in another, and the trees taper and become narrower in the vertical direction. These irregularities in shape necessitate measuring both the short and long diameters and averaging the two measurements to obtain the average diameter. An error in diameter measurement may have a great effect upon the computation of volume; a 1-inch (2.5 cm) loss in diameter measurement has the same effect as an 8-foot (2.4 m) error in height measurement.

6 The diameter tape is a device for converting the circumference of a tree to its diameter, and its readings are direct and precise. The tape may have a bark hook at its zero end. Correct use is to hold the case in the right hand with the winding handle up. When the tape is pulled tightly around the tree, the diameter scale is right side up and the diameter value lies directly below the zero of the scale. A common length is 20 feet (6 m), scaled on one side in feet, tenths, and hundredths of feet to indicate circumference, and on the other side to give diameter

diameter breast height 胸径
caliper *n.* 卡尺；卡钳
cylinder *n.* 圆柱状物
circumference *n.* 周长

equivalents inches and tenths of in inches up to 76.5 diameter inches (194 cm).

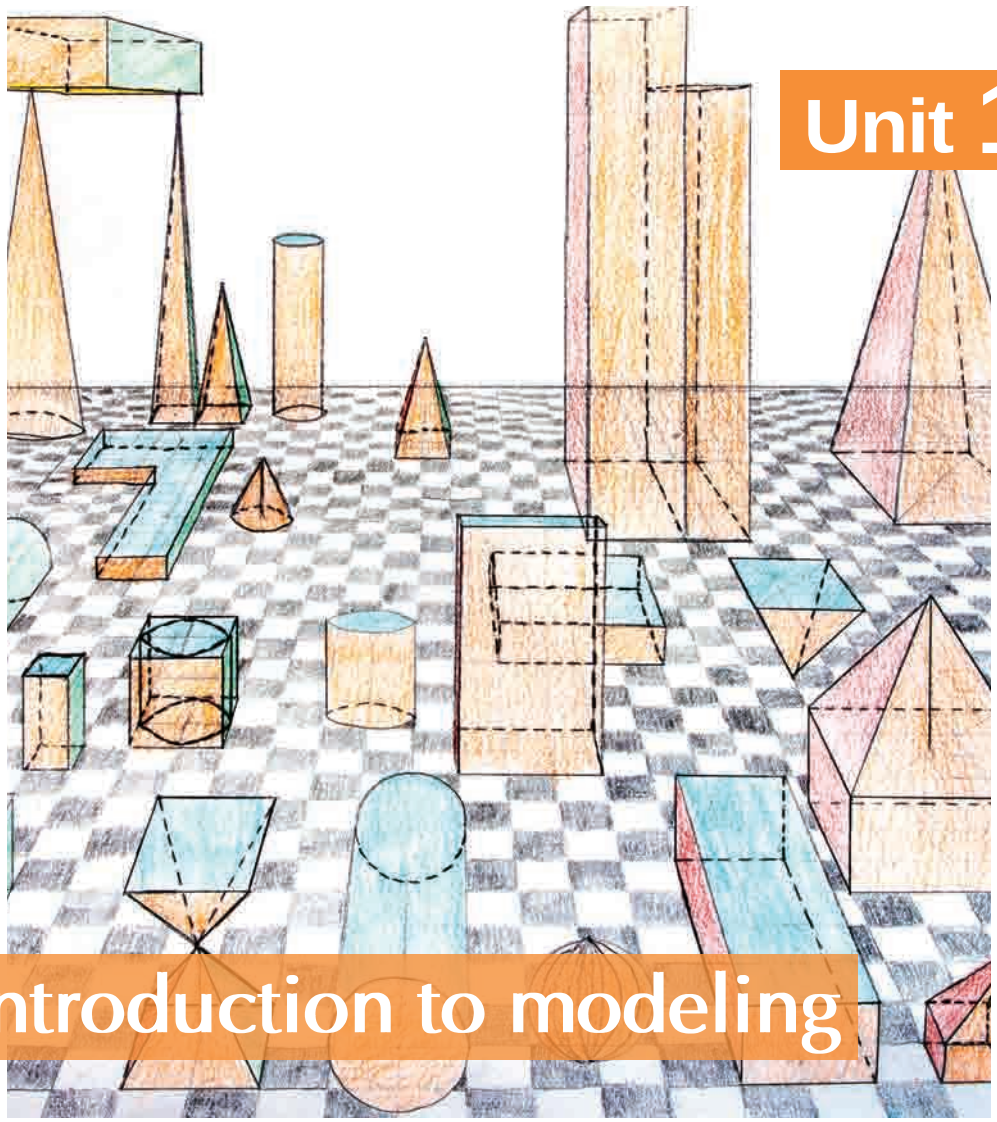
7 The tree caliper is made either of wood or metal and provides a quick and simple method of measuring dbh on trees that are nearly cylindrical. It is a rather simple device consisting of a bar and two legs, one fixed and the other free to slide along a graduated scale on the bar. When the legs are located tightly against the opposite sides of a tree, the instrument gives measures of dbh to the nearest tenths of an inch. Calipers are wed conveniently for trees up to about 20 inches (50 cm) dbh. For bigger trees, the diameter tape is preferred because large calipers are cumbersome and awkward to handle.

8 The Biltmore stick was designed by C. A. Schenck for use by his students in the first forestry school in the United States, the Biltmore Forest School near Asheville, North Carolina. Schenck called it the "Biltmore stick" after the name of his school. (The site of this old forestry school and its general proximity are often referred to as "the cradle of forestry in the United States".)

9 The standard Biltmore stick is made of wood, 25 or 30 inches (63.5 or 76.2 cm) long. It is so scaled that when held horizontally against a tree trunk at the customary height (4½ feet or 137 cm) with the cruiser's (timber volume inventory specialist) eyes 25 inches (63.5 cm) from the tree, the diameter may be read to a closeness of 1 inch for smaller trees and 2 inches for larger ones. The observer must hold his or her head still until the left end of the stick is exactly in line with one side of the tree. The graduation which is then in line with the other side of the tree corresponds to the diameter. The diameter scale is marked in inches in ½-inch (1.27 cm) steps.

10 The Biltmore stick is not an accurate instrument because the 25-inch (63.5 cm) distance from the eye is difficult to control, but it is convenient to use. It is accurate enough for dbh measurements in estimating 1-inch (2.54 cm) and 2-inch (5 cm) diameter classes if it is employed carefully. Many experienced timber cruisers can estimate a tree's diameter within an inch or so, but they usually check their accuracy with one of the instruments discussed above.

cradle *n.* 摇篮；发源地



Unit 1

Introduction to modeling

In this unit, you will learn:

- **Subject-related knowledge:** Color theory
  Design sketch
- **Academic skill:** Searching for information
- **Reading strategy:** Dealing with unknown words (Part I)

Section A

Pre-reading

1 **Answer the following questions to test how much you know about some basics of color theory.**

Q1. What is a primary color?

A. Any color of the rainbow.

B. A color made from mixing two others.

C. A color that cannot be made by mixing any other colors.

D. A color made by mixing three colors together.

Q2. List the primary colors you know.

_____

Q3. What do you get when you mix two primary colors together?

A. A secondary color.

B. A cool color.

C. A warm color.

D. An adjacent color.

Q4. When yellow and purple are used together in a composition, they are referred to as being _____.

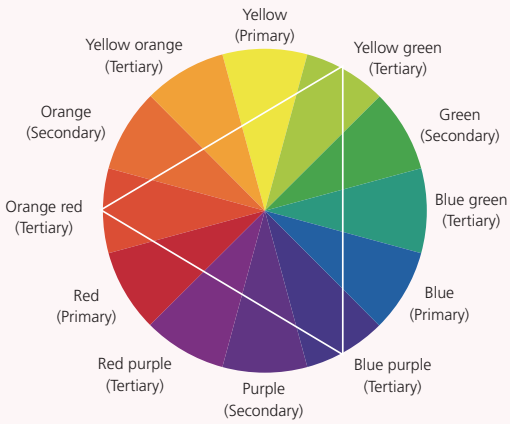
A. unbalanced B. complementary

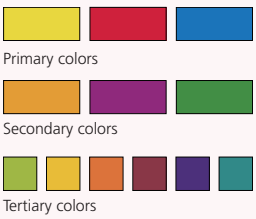
C. dull D. gloomy

Share the reasons for your choice in Q4 with your partner(s).

1 Color theory is a set of principles used to create harmonious color combinations. Understanding color theory in art and design helps our appreciation of the different ways in which artists use this visual element.

2 A primary color is a color that cannot be made from a combination of any other colors. A secondary color is a color created from a combination of two primary colors. A tertiary color is a color made by mixing either one primary color with one secondary color, or two secondary colors, in a given color space.





Text A

Color theory

3 Printers and artists have different definitions for primary colors. The traditional primary colors that painters have used are red, yellow, and blue. Modern printing press primary colors are magenta, yellow, and cyan. These two primary color systems obviously do not agree. Additive color process and subtractive color process are the two primary methods for reproducing a range of colors.

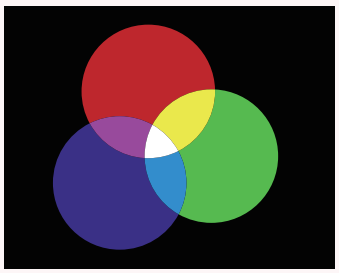
Additive color

4 Additive color synthesis is the creation of color by mixing colors of light. Human vision relies on light-sensitive cells in the retina of the eye. There are two basic kinds of sensors. They are rods and cones. Rods are cells which can work at very low intensity, but cannot resolve sharp images or colors. Cones are cells that can resolve sharp images and colors, but require much higher light levels to work. The combined information from these sensors is sent to the brain and enables us to see.

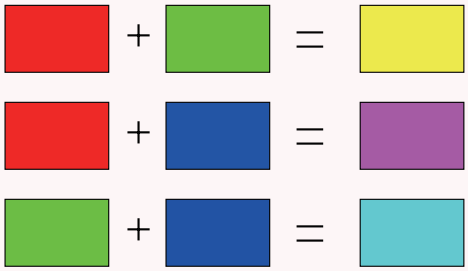
5 There are three types of cones. Red cones are sensitive to red light; green cones are sensitive to green light; and blue cones are sensitive to blue light. The perception of color depends on an imbalance between the stimulation level of these three cone types.

6 The three primaries in light are red, green, and blue, because they correspond to the red, green, and blue cones in the eye. Example 1 shows how the light from red, green and blue flashlights would appear if shone on a dark wall.

7 Additive color processes, such as television, work by having the capability to generate an image composed of red, green, and blue light. Since the intensity information for each of the three colors is preserved, the image color is preserved as well. The spectral distribution of the image will probably be



Example 1: additive principle of color combining (light)



Derivation of additive secondaries from additive primary colors

wrong, but if the degree of intensity for each of the primary colors is correct, the image will appear to be the right color.

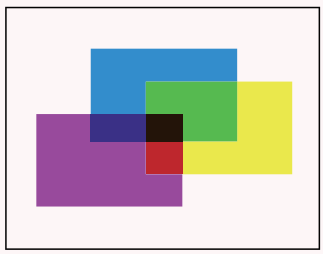
Red + Green = Yellow
Red + Blue = Magenta
Green + Blue = Cyan
When all of the colors of the spectrum are combined, they add up to white light.

Subtractive color

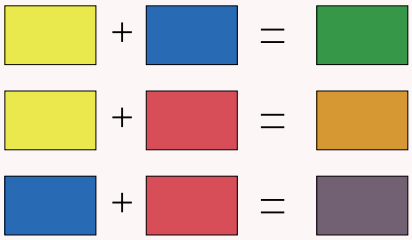
8 This type of color is what is used in the art and design world. When learning basic color theory, art students typically use familiar colors like red, yellow, and blue.

9 Subtractive color processes work by blocking out parts of the spectrum. The idea of subtractive color is to reduce the amount of undesired color reaching the eye. If, for example, you want a yellow image, you would need to have a dye that would let red and green reach the eye, and block out blue. The additive secondaries become the printer's subtractive primaries, because each of the additive secondaries will reflect two of the additive primaries, and absorb one of the additive primaries.

10 The three primaries on the artists' color wheel are red, yellow, and blue. Example 2 illustrates subtractive color by showing how primary colors mix on a piece of white paper.



Example 2: subtractive principle of color combining (pigment)



Painting primaries mixing chart

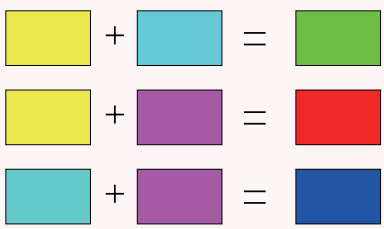
Yellow + Blue = Green
Yellow + Red = Orange
Blue + Red = Violet
When all of the colors are combined, they create black pigment.

Color	Reflect	Absorb
Yellow	Red and Green	Blue
Magenta	Red and Blue	Green
Cyan	Green and Blue	Red

Subtractive primaries / additive secondaries absorption chart

11 With this information, if we wanted red, we would mix magenta and yellow. Magenta would absorb green, and yellow would absorb blue, leaving only red to be reflected back to the eye. For black, a combination of all three would be used, which should block out all light in theory. Printers use black as well, since the dyes used in printing are not perfect, and some light from other parts of the spectrum gets through.

For printers' mixing:
Yellow + Cyan = Green
Yellow + Magenta = Red
Cyan + Magenta = Blue



Subtractive primaries mixing chart

Description of color

12 **Hue:** the name of the color itself, the dominant wavelength of light or the choice of pigment.

Lightness (brightness): the lightness or darkness of the color, or the amount of light reflected or transmitted.

Saturation: the level of white, black or grey, ranges from neutral to brilliant (from pastel to full color).

Tint: base color plus white.

Tone: base color plus grey.

Shade: base color plus black.

Value: How light or dark a color is.

Aggressive – aka "warm": the colors of yellow, orange, and red, etc. These come toward the eye more (spatially) and are generally "louder" than passive colors.

Passive – aka "cool": the colors of green, blue, and violet, etc. These recede from the eye more (spatially) and are generally "quieter" than the aggressive colors.

Color schemes

13 **Achromatic:** An achromatic color scheme is one that is colorless – using black, white and gray.

Complementary: A complementary color scheme is one that uses colors directly across from each other on the color wheel. This can be accomplished by using two colors or hues that are opposites such as red and green or violet and yellow. Black and white can also be used. Since you can choose from varying colors and hues which can give a bold and dramatic effect, this color scheme is best used for dramatic, strong, or bold statements.

An example of a complimentary color scheme

Monochromatic: A monochromatic color scheme is a one-color color scheme. However, the color can be neutralized by adding its complement to lower the intensity of the color. Black and white can also be used to darken and lighten the value of the color. It is achieved by using one color or hue, utilizing that color's various tints, tones and shades. Using a monochromatic scheme with multiple textures creates character and maintains unity.

An example of a monochromatic color scheme

Analogous: An analogous color scheme is any three adjacent primary, secondary, or tertiary colors on the color wheel. These schemes can be warm or cool. Each can be neutralized by use of its complement, and black and white can be used. Analogous colors “harmonize” well and produce a definite mood to a composition. This can create a very harmonious color scheme.

An example of an analogous color scheme

Color triad: A triadic color scheme is colors that are equally distant from each other on the color wheel. Any three colors equidistant around the color wheel form a triad and can be used in this color scheme (e.g. red, yellow and blue).

An example of a color triad

Color tetrad: The tetradic or rectangle color scheme uses four colors arranged into two complementary pairs.

Color diad: A diadic color scheme is one using two colors that are two colors apart on the color wheel (e.g. red and orange).

Split complementary: A split complimentary color scheme is similar to the complimentary one. But instead of just two colors directly opposite on the color wheel, in the split complimentary color scheme, two of the three colors are adjacent to one of the colors that is opposite.

New words and expressions

magenta /mə'dʒentə/ *n.* 洋红色

cyan /'saɪæn/ *n.* 青绿色

subtractive /səb'træktɪv/ *adj.* 减色法的

synthesis /'sɪnθɪsɪs/ *n.*
the combination of two or more elements or components to create something new 综合；结合

retina /'retɪnə/ *n.* 视网膜

sensor /'sensə(r)/ *n.* 传感器；感应器

rod /rɒd/ *n.* 视杆

cone /kəʊn/ *n.* 视锥

intensity /ɪn'tensətɪ/ *n.*
the strength of light that can be measured（光的）强度

resolve /rɪ'zɒlv/ *v.*
to make clearly visible 分辨

perception /pə'sepʃən/ *n.*
the ability to see, hear or understand 感知能力；认识能力

spectral /'spektrəl/ *adj.* 谱的；光谱的

derivation /ˌderɪ'veɪʃən/ *n.*
the origin of something 起源；由来

spectrum /'spektrəm/ *n.* 光谱

pigment /'pɪgmənt/ *n.* 色料

dye /daɪ/ *n.*
substance used for dyeing 染料

absorb /əb'sɔːb/ *vt.*
to take in 吸收；吸进

absorption /əb'sɔːpʃən/ *n.*
the process of a liquid, gas or other substance being taken in 吸收

hue /hjuː/ *n.*
color 颜色

wavelength /'weɪvleŋkθ/ *n.* 波长

saturation /ˌsætʃə'reɪʃən/ *n.* 色饱和度

neutral /'njuːtrəl/ *adj.* 非彩色的；不鲜艳的

pastel /'pæstəl/ *n.*
a pale soft color 淡而柔和的颜色

tint /tɪnt/ *n.* 色温；色彩

tone /təʊn/ *n.* 色调；影调

aka
also known as 又名；亦称

spatially /'speɪʃəli/ *adv.*
concerning or existing in space 空间地

recede /rɪ'siːd/ *vi.*
appear to be more distant 变模糊；变淡

scheme /skiːm/ *n.*
ordered system 组合

achromatic /ˌækrəʊ'mætɪk/ *adj.* 无色的

complementary /ˌkɒmplɪ'mentərɪ/ *adj.* 补充的

monochromatic /ˌmɒnəʊkrəʊ'mætɪk/ *adj.* 单色的

analogous /ə'næləgəs/ *adj.*
similar to another situation or thing so that a comparison can be made 类似的；相似的

adjacent /ə'dʒeɪsənt/ *adj.*
next to or near something 邻近的；毗连的

triad /'traɪəd/ *n.*
a group or set of three related people or things 三人或三物的组合

equidistant /ˌiːkwɪ'dɪstənt/ *adj.*
at an equal distance 等距离的

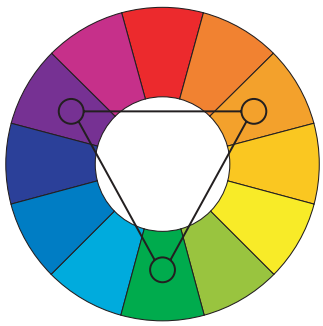
tetrad /'tetræd/ *n.*
a group or set of four related people or things 四个一组

diad /'daɪæd/ *n.* 一对；一双

primary color 原色
secondary color 二级色；间色
tertiary color 三级色；复色
printing press 印刷机
spectral distribution 光谱分布
base color 基本色
color scheme 色系
color wheel 色轮；色环
triadic color 三色
tetradic color 四色
diadic color 双色

Reading comprehension

There are eight color schemes mentioned in Text A. Give the names of the color schemes the following pictures symbolize and find the phrases or sentences which help you get the answer from Text A.



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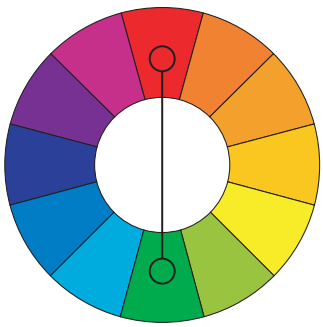

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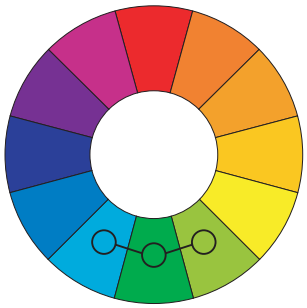

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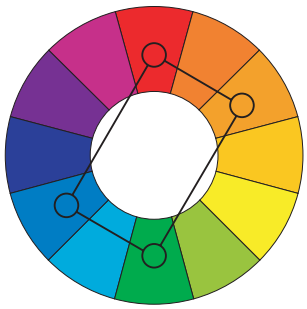

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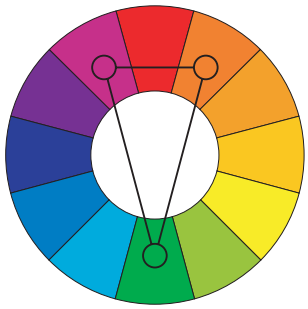


Name: _____

Language focus

1 Match the Chinese on the left and right with the English words in the middle and compare their meanings. Complete the following sentences with appropriate words in the middle. Change the form if necessary.

1. 侵略的	shade	A.（色彩的）明暗程度
2. 安静的	value	B. 暖色调的
3. 作文	aggressive	C. 加色的
4. 价值	additive	D. 暗淡的
5. 背阴处	composition	E. 阴影
6. 添加物	quiet	F. 构图

1. The organization of foreground, middle ground, and background; perspective, cropping, movement, and depth; as well as subject placement and body posture is important in the process of _____.
2. Combining _____ colors creates lighter colors, so adding all three primary colors results in a color so "light" that it's actually seen as white.
3. Those women dress in _____ colors so as not to call attention to themselves when they go out.

4. _____ is a measure of how light or dark a color is, without any consideration for its hue.
5. To human eyes, orange is a very hot color, so it gives the sensation of heat. Nevertheless, orange is not as _____ as red.
6. A(n) _____ is simply any color with black added. It is deep, powerful and mysterious. Be careful not to use too much black as it can get a little overpowering.

2 Study the prefixes of numbers. Try to use the correct form of the italicized words given below to complete the following sentences. Change the form if necessary.

one – uni / mono	e.g. *unity*, *monochromatic*
two – di / bi	e.g. *diad*, *bicycle*
three – tri	e.g. *triad*, *triangle*
four – tetra / quadr	e.g. *tetrad*, *quadrangle*
five – penta	e.g. *pentagon*
six – sex	e.g. *sexfoil*
seven – sept	e.g. *septilateral*
eight – octo	e.g. *octopus*
nine – nona	e.g. *nonary*
ten – deca	e.g. *decade*
half – semi / hemi	e.g. *semi-neutral*, *semispherical*, *hemisphere*

1. A(n) _____ color scheme uses colors that are evenly spaced around the color wheel. It tends to be quite vibrant, even if you use pale or unsaturated versions of your hues.
2. In Vincent van Gogh's *Self-Portrait*, both the figure and the background are so overwhelmingly soaked in a pale cornflower blue that the painting is almost a(n) _____ study of dull, cerulean emotion.
3. In the art class, the teacher showed to the students how to draw a(n) _____, a regular five-sided figure, and asked them to draw one by themselves.
4. The _____ of the brains have separate and distinct functions.
5. After years of research, Swedish designers have released the "Hövding", an innovative _____ helmet design in which an airbag is housed

within a stylish collar and engineered to inflate and encompass a cyclist's head during a collision.

6. The _____ color scheme uses four colors arranged into two complementary pairs. This rich color scheme offers plenty of possibilities for variation.

3 **Complete the following sentences with the words given below. Some of the words may not be used. Change the form if necessary.**

subtractive composition tint saturation intensity complementary shade additive lightness

1. If we are working on a computer, the colors we see on the screen are created with light using the _____ color method. When we mix colors using paint, or through the printing process, we are using the _____ color method.
2. A color can be toned down, neutralized, or desaturated by adding a bit of the _____ color (opposite on the color wheel) to it. For example, red can be made less vivid by adding a bit of green to it.
3. Value is how light or dark a color is in terms of a black and white scale. You can lighten or _____ a color by adding white; you can darken or _____ a color by adding black.
4. In the case of two-dimensional images, _____ describes the way that different elements are positioned within the frame, with respect to each other and to the viewer, to create a particular impression.
5. In the Munsell color system, zero represents neutral grey, and depending on the hue, the numbers 10 to 16 represent complete _____.
6. _____ is the brightness or dullness of a hue. One may lower the _____ by adding white or black.

4 **Translate the following paragraph into English.**

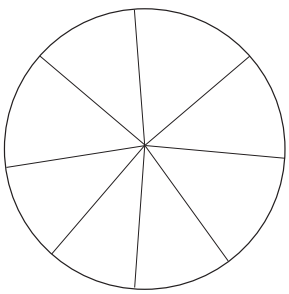
当谈到色光，颜色是加色法，意指添加更多的色光使颜色更明亮。当把所有的色光原色混合在一起时，得到的就是白色色光。色光的原色是红、绿和蓝。这些跟我们视网膜里的受体细胞（receptor cell）是相对应的。当谈到色料（pigment）时，颜色是减色法，意指光被吸收了，添加了更多的色料使得颜色变暗。当所有的色料原色混合在一起时，得到的就是黑色。色料的原色是洋红、黄和青绿。

Critical thinking

1 **Read the sentence in italics and discuss the following questions in groups.**

"Blue is the only color which maintains its own character in all its tones. Take blue in all its nuances, from the darkest to the lightest – it will always stay blue." – Raoul Dufy

1. There are many kinds of blue, for example cyan as we mentioned in Text A. Name as many blue as you can and write them down on the following wheel.



2. What do you associate with the color blue?

2 **Look at the following picture. What colors are used in it and how do you feel about the colors?**

Research task

Academic skill: Searching for information

Information can come from virtually anywhere – media, blogs, personal experiences, books, journal and magazine articles, expert opinions, encyclopedias, and web pages, etc.

1. Types of information

Type	Use
Magazine	• To find information or opinions about popular culture. • To find up-to-date information about current events. • To find non-scholarly articles about topics of interest within the subject of the magazine.
Academic journal	• To get help for your scholarly research. • To find out what has been studied on your topic. • To find bibliographies that point to other relevant research.
Database	• To find articles on specific topics. • To find online journals or news articles.
Newspaper	• To find editorials, commentaries, expert or popular opinions. • To find current local, national or world news.
Library catalog	• To find virtually any topic. • To find hard copies of current or back issue of journals, books, newspapers or magazines.
Website	• To find information from all levels of government – central to local. • To find expert or popular opinions. • To find information of various types of media, e.g. illustrations, audio and video information.

2. Searching for information

Author / Title search

Searching by author and / or title obviously assumes that you are searching for a particular author, book or article, probably in either a database or a library catalog. Here are some tips:

- When searching by author, put the author's last name first, e.g. "Kotler, Philip", not "Philip Kotler", if he is from an English-speaking country. Search the author's full name in Chinese order if he is a Chinese. Sometimes, the

author could be an organization, so give the full name of the organization as it commonly appears, e.g. "World Bank".

- When searching by title, it helps if you enter the title as correctly as possible.

Keyword search

It is basically a way of searching through subject or topic. Most library catalogs and databases will include an option to search by keyword as an alternative to author and title. The first step of keyword search is to decide the key word(s) or phrase(s). Normally, the word(s) or phrase(s) which can cover the topic you search can be selected as keyword(s). A good research topic usually contains two or three concepts. For example, you need to write a paper on "The Impact of Cognitive Styles on Design Students' Spatial Knowledge". We can break the topic into concepts, like "cognitive styles" and "spatial knowledge", which can be used as keywords. Then type them in a search bar in a database, EBSCOhost for instance. In a database, there are usually two ways of search, i.e., basic search and advanced search.

Basic search (see Fig. 1) generates a large number of sources for you to differentiate, which is an exhausting task. But advanced search (see Fig. 2), which provides more choices for further conditioning, can make the work lighter. There are many variables that can be chosen to refine the search. And you can define the relationship between the keywords by choosing "and", "or" or "not" based on the results you intend to obtain.

Fig. 1 Basic search

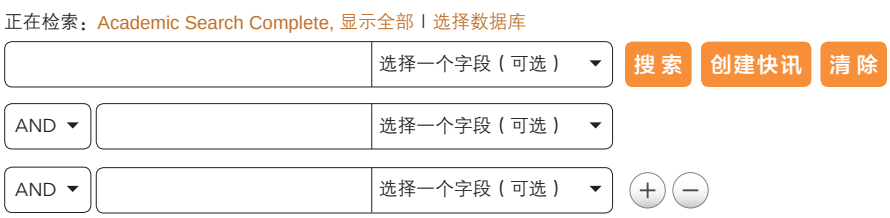


Fig. 2 Advanced search

As "cognitive styles" is a broader topic and "spatial knowledge" is more specific, they can be typed in the upper and middle search bars respectively. More relevant results will appear. You can then refine the search by selecting a specific variable. In this case, "subject" (主题语) can be chosen to filter the results (See Fig. 3).

Fig. 3

Snowball search

It is a good way if your topic has a key work or author. You can trace the citations of that author using a specialized citation database, such as the Social Science Citation Index to obtain other key works or authors. You will follow the stream of research up to the near present and see the way in which the work or the author has influenced the subsequent studies.

3. Evaluating information

Once you have found information that satisfies the requirements of your research, you should evaluate it. Evaluating information encourages you to think critically about the reliability, validity, accuracy, authority, timeliness, point of view or bias of information.

When evaluating information, you can use the five criteria AAOCC, namely, Authority, Accuracy, Objectivity, Currency and Coverage. They can be applied to check all information.

1) Authority of information
   - Who published it?
   - What institution published it?
   - Does the publisher list his or her qualifications?

2) Accuracy of information
   - Who provided it, and can you contact him or her?
   - Does it provide enough details?
   - Has it been cited correctly?
3) Objectivity of information
   - What is the purpose of it, or why was it published?
   - Is it biased?
   - What opinions (if any) are expressed by the author?
4) Currency of information
   - When was it published?
   - When was it updated?
   - How up-to-date is it?
5) Coverage of information
   - Do citations in it complement the research?
   - Is it all text or a balance of text and image?
   - Is it free or is there a fee to obtain it?

Task

The picture is Pierre-Auguste Renoir's Dance at Bougival. Search some basic information about the picture on the Internet (the author, the creation background) and then work in groups and discuss the colors used in this picture and complete the following table.

Author		
Creation background		
Color	Color	Function
	Suit and dress	
	Hat	
	Palette	
	Background	

Section B

Reading strategy

Dealing with unknown words (Part I)

The ability to deal with unknown words is a key reading skill in the reading process. It is a vital skill because you are almost certain to find unknown or unfamiliar words in any text. The skill is not necessarily to "know" the words, but to guess the meaning of them so that you can read and understand the whole text. Here are several different ways that can help you guess the meaning of an unknown word.

Guessing by explanation

Sometimes, you will find that the meaning of an unfamiliar word is given to you in the text. Typically, the phrase or sentence immediately before or after the unfamiliar word may give you a hint about the word. In this case, what you need to do is keep on reading and do not stop at the moment when you find the unfamiliar word, and then guess the meaning from the context. For example:

An achromatic color scheme is one that is colorless – using blacks, whites and grays.

"Achromatic" may be unfamiliar to you. However, if you read the sentence above "… is one that is colorless – using blacks, whites and grays", it is obvious that "achromatic" should mean "colorless".

Guessing by synonyms and antonyms

This is a very useful skill to learn. What you should do here is look at other words which relate to that word and work out what it may mean. These words may be either synonyms (words with a similar meaning) or antonyms (words with an opposite meaning). For example:

Aggressive – aka "Warm": …

Here you can work out the meaning of "aggressive" by its synonym "warm". All you need to do is to read the rest part of the sentence and think of the meaning of it.

Guessing by the part of speech of a word

This is the weakest skill in that it gives you the least amount of information about the word. However, it can sometimes help to know whether you are looking at a verb, noun, adverb or adjective. For example:

Example 1 shows how the light from red, green and blue flashlights would appear if shone on a dark wall.

In this text, we have an unusual word "flashlight". You can tell the word must be a noun as it follows the three adjective "red, green and blue" and this helps you understand that it must be a thing of some sort.

Task

Read Text B and apply the skills above to deal with the underlined words.

Text B

Design sketch

1 Designers use different forms of visual expression in the design process. One of the most commonly used forms of visual expression is sketching or drawing. During the design process, sketches change in shape and content according to different purposes.

2 There are different classifications of the sort of sketches used in the design process. One of such classifications differentiates between the thinking sketch, the talking sketch and the prescriptive sketch. The thinking sketch refers to the sketch used to support the individual thinking process of designers. It focuses on the generation and development of ideas into concepts. The talking sketch refers to the sketch used to present and discuss ideas and concepts in design teams. The prescriptive sketch refers to the drawing used to communicate design decisions. The prescriptive sketch is used mostly in the latter (pre-manufacturing) stages of the design process. The prescriptive sketches are detailed drawings or technical drawings.

3 The followings are some of the classifications of different types of design sketches.

Idea sketches

4 Idea sketches are made in the early idea generation phase. The goal is to find many ideas based on the information from the problem analysis phase. Sketches are simple, with as little detail as possible and schematic. First ideas that come into mind often get stuck. Sketching in the early idea generation has the goal of relieving oneself of those early, stubborn ideas.

Concept sketches

5 After the early idea generation there is a need for more elaborate sketches. Concept sketches accompany the presentation of a concept. Integral solutions now come into being, based on a better understanding of the problems. Concept sketches provide information about average size, shapes and possible materials that could be used. But several solutions are still looked for. To make a valid decision, the concepts need to be judged according to the requirements. Therefore the concept sketches need to be on the same level of detail and from the same perspective. Concept sketches are different from idea sketches because they are in proportion, have more detail, and show material and color. Aspects such as construction, ergonomics and functionality are also being shown in concept sketches. Concept sketches are often annotated with remarks.

Detail sketches

6 The design is now globally defined, but many details need to be resolved and clarified. Detail sketches show details such as connections, form transitions, materials, final product and moving parts.

7 These aspects are developed in detail sketches with manufacturing and assembly in mind. Detail sketches show different points of perspective, and often include also two-dimensional sketches. Detail sketches need to be in scale.

ergonomics *n.* 工效学；人类工程学

Dimension sketches

8 Before the formal technical drawings can be made, the design needs to be dimensioned. The exact sizes and measurements need to be determined in dimension sketches. Dimension sketches consist of two-dimensional sketches of the front, side, and top and different cross sections. Particular conventions are recommended such as the American Projection Method.

Technical drawings

9 From the dimension sketches there is enough information to produce technical drawings. Nowadays these kinds of drawings are just a part of the technical documentation (TecDoc) package which consists of digital three-dimensional models of parts and (sub-)assemblies (components, products) and derived animations, renderings and technical drawings. All these TecDoc items are made using software such as SolidWorks or AutoCAD. The three-dimensional model is the carrier which can be used for presentation, as an input model for simulations or the generation of technical drawings as mentioned.

10 The art of technical drawing has to be done according to international standards. Technical drawing systems include mono drawings, assembly drawings and often sub-assembly drawings. Technical drawings are for the final production of the design. They are also used to check the dimensions of the final product after production (quality control). This becomes more and more important nowadays for it's common to send three-dimensional geometries to computer controlled production machines.

Cross section drawings

11 Cross section drawings present a cross section of the product's geometry at different locations of the product. In order to make a cross section drawing, the geometry, layout and dimensions of the design have to be known. Cross section drawings allow designers to think through how the inside of the product

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geometry *n.* 几何形状；几何结构
cross section *n.* 横截面（图）；剖面（图）

is constructed. Cross section drawings can be made with the use of software (SolidWorks) but are preferably made by hand.

Presentation drawings

12 Presentation drawings are sketches that include aspects such as form, size, color, material, and surface finishing of the final product. Presentation drawings are sketches that provide rich information, preferably with information about its context of use and interaction. Presentation drawings could be used for marketing purposes and sales. A prototype and presentation drawing often conclude a design process, of which the presentation is a cheaper alternative to present the final product concept. Different points of view provide a presentation drawing with more information. One important aspect of products is that they often come in more than one color. A color study therefore could complement the presentation drawings. Important aspects when choosing the right color range are: tone of the color, brightness and saturation.