高等学校学术英语（EAP）系列教材

第二版

学术英语

理工

蔡基刚 编

ACADEMIC ENGLISH *for* SCIENCE AND ENGINEERING

外语教学与研究出版社
FOREIGN LANGUAGE TEACHING AND RESEARCH PRESS

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前言

一、编写理念

今天的大学英语教学所面临的环境，与过去相形而言，已发生了很大变化。1）中小学英语教学水平的不断提高要求大学英语教学必须去同质化，即大学生不能再像中小学生那样单纯为掌握英语知识而学习英语，而应该是为应用而学习英语；2）《国家中长期教育改革和发展规划纲要（2010-2020年）》提出需要培养大批在专业领域具有国际竞争力的人才，推进一流大学和一流学科的建设，这意味着高校大学英语教学应致力于培养大学生用英语直接从事专业学习的能力；3）英语是全球学术通用语（将近90%的科技文献都是用英语写成的），这一事实要求每一个合格的大学生，不管是重点大学的还是高职高专的，不管其专业课程是用英语授课的还是用母语开设的，都需要具备用英语阅读本专业或本行业文献的能力，以更好地了解该领域世界前沿的发展情况。《学术英语 理工（第二版）》（以下简称《理工》）就是在这样的背景下，为适应国家和大学英语教学的新需求而编写的。

学术英语可以分为通用学术英语（EGAP: English for General Academic Purposes）和专门学术英语（ESAP: English for Specific Academic Purposes）。前者主要训练学生跨学科的学术口语交流能力和学术书面交流能力；后者则是训练某一学科领域内的特定表达方式和交际能力。通用学术英语到专门学术英语是一个连续体，当中应该还有一个具有大类学科（如大文科、大理科）特点的学术英语，既不是和专业完全无关的通用学术英语，也不是只涉及某一专业的专门学术英语（如法律英语、医学英语、石油英语等）。《理工》就是这样一个大类学科学术英语。根据美国《科学引文索引》（SCI），理工覆盖了生命科学、临床医学、物理、化学、农林、工程技术等176个学科。《理工》这本书选材涉及自然科学和工程技术等多个学科，包含核能辐射、大气环境、食品安全、医学卫生和纳米材料等话题，同时涵盖这些领域里共核的、跨学科的学术英语技能。

《理工》这本书的定位是：1）提高学生在高等教育环境中的听说读写能力（区别于日常生活中的听说读写能力）；2）提高理工科学生的学术技能（如听讲座、记笔记、阅读学术文献、撰写论文、宣读论文、参加学术讨论等）；3）提高学生学术素养（如运用网络和图书馆资源搜索信息进行自主学习和独立研究；分析和综合从各个渠道搜集来的信息并进行评价、提出问题，培养创新思维和批判性思维能

力；交流沟通，用团队合作的方式开展基于项目的学术研究等）；4）帮助学生了解特定学科专业所用的各种语类，尤其是期刊和会议论文的结构及特定的学术传统与范式。《理工》除了培养通用学术英语这四种能力和素养外（蔡基刚，2015，2016a），也注意到了引导未来科学工作者和工程技术员形成应有的社会责任感和伦理规范。

二、教材特色

《理工》采用的是"以结果为导向"（outcome-oriented）的学术英语教学法。理工科学生在学习或工作中，出于查阅专业文献、参加国际学术论坛或研讨会、向科技期刊投稿的需要，必须能够迅速从专业学刊中汲取信息，写文献综述或学术小论文，或设计学术论文海报进行展示。整个《理工》就是围绕这些特定目的而展开各种学术英语技能教学的。因此，《理工》主要按三条主线编写。

Critical Reading：阅读输入部分。本书各单元都有一篇专业文献*（直接选自*Nature*等期刊或会议论文）作为主课文。这样选材的原因，是专业文献大多以期刊和会议论文形式出现，包括摘要、引言、方法、结果、讨论和参考文献这些学术论文最基本的要素；再者，一个理工科大学生无论信息汲取（阅读）还是信息表达（写作），都必须掌握该领域内学术文章最基本的语篇特征，如定义、分类、比较、解释、综述、引用等，而这些语篇特征在专业文献中反映最为典型。

Academic Writing / Presentation：写作或口语输出部分。本书各单元按照学术论文写作的步骤（IMRD：Introduction-Methods-Results-Discussion）安排内容，第一单元到第六单元的写作主题分别为：如何选择论文的主题，设计研究问题；如何收集写论文所需要的书面和听力资料，辨别可靠的信息；如何写文献综述和引言部分；如何写方法介绍和结果处理部分；如何写讨论、结论和摘要部分；如何进行论文演示陈述和写海报展示论文。六个单元非常具体地一步一步传授论文写作和国际学术交流的方法。每一步都配以大量的练习，以保证对知识的掌握和应用。

Literacy Skills：这一部分是讲如何遵守学术规范，培养基本的学术素养。六个单元分别介绍了如何防止学术剽窃（如改写句子、总结段落、概括全文、注明出处

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* 本书所选专业文献可能存在部分数据统计错误。为尊重原作者，我们未对这些错误进行纠正。

等基本方法），如何综述和组织不同来源的材料，如何使用正式文体的词汇和结构，如何运用恰当的模糊限制语，如何写参考文献等等。

《理工》尝试用“以结果为导向”的学术英语教学方法编写教材，这在国内尚属首次。它结合正式期刊或会议论文传授英语听说读写技能，训练学术英语写作技能，培养学术素养，这在国际上也是创新的。

三、教学方法

《理工》主要采用三种学术英语教学方法。

合作分工阅读。《理工》课文的平均长度为2500词（为了控制难度，生词密度在2.5%，远低于目前大学英语教材的平均生词密度4%）。对于初次接触长篇学术文章的学生来说，教师可以采用国际上比较流行的Reading Circles方法，把全班分成每组6-7个学生的若干小组，组内设讨论组长（设计所讨论的问题，组织讨论）、资源寻找员（寻找和课文相关的文献，补充信息）、内容阐述员（阐述研究的目的、方法、问题、结果等）、互文联系员（比较课文与同类研究的异同）、批判思辨员（分析作者的态度、偏向、论据和论文可能存在的问题等）、关系分析员（画出文章结构图等）和语言分析员（分析生词、学术词汇、常见搭配和句型等）。角色可以随着阅读任务的推进进行轮换，以锻炼学生驾驭每个角色的能力（蔡基刚，2016b）。

基于项目教学。步骤如下：全班围绕单元课文主题共同讨论和设计多个相关小课题；分组领取课题，组内讨论课题的研究问题，提出假设；组员分头搜集材料和调查；小组集中，整合和评价所搜集到的信息；专人撰写调查报告交全组讨论；各组在基于课文主题的全班论坛上交流自己的课题结果。其中每一步教师都要穿插讲授论文写作技能和学术规范知识。期末可以要求每个学生就教材中任何一个主题写出一篇1500词以上的正式学术论文，题目自选。在课程结束时举办课程学术研讨会，每个学生将自己的论文或研究成果通过陈述演示和海报演示进行交流。

批判性思辨能力培养。《理工》颠覆了传统的循循诱导和“正确”价值输入的教学方法，注重培养学生通过独立思考形成自己的观点和结论，即提出问题和解决问题的能力。因此，《理工》专门设置了提出质疑（asking questions）、发现结论和支撑结论的论据（identifying conclusions and reasons）、发现作者隐含

的观点和结论（identifying hidden assumptions and conclusions）、使用思维图（using argument mapping）、鉴别证据的有效性（examining evidence）和区分事实和观点（distinguishing between facts and opinions）六大技能专题，并配以大量练习。具体涉及的问题有：若改变本研究方法、寻找不同群体做实验，或运用不同理论来解释，结果是否不同；作者是如何构建其观点和结论的；结论所用的证据是什么类型、是否可靠，解释是否充足；作者背后隐藏的意图是什么等等。这种把批判性思辨能力培养的练习放在学术英语教材中的尝试是国内教材中的亮点。

四、使用建议

《理工》教材的适用对象为有以下要求的大学生：1）想提高阅读英语文献并从中汲取专业信息的能力；2）想掌握用英语撰写文献综述和小论文的基本写作技巧；3）想听懂学术讲座并希望到国际学术会议上交流自己的论文；4）想在满足上述需求的同时进一步提高听说读写能力。

除此之外，《理工》注重发挥学术英语教学大纲和方法培训的作用。学术英语和目前普遍开展的大学英语通用英语在教学目的和方法等方面有七个方面的区别（蔡基刚，2016a）。不经过培训，一个大学英语教师是无法成为合格的学术英语教师的。这本教材也是我国学术英语教学的指南，目的是帮助教师在学术英语教学理念、教学方法和科研能力等方面都得到提高，最终成长为学术英语教学的骨干教师和专家学者。

《理工》教学对象可按层次分为两大类：1）初步达到大学英语三级水平的大学新生或大学二年级学生；2）硕士研究生的新生。

目前各校的大学英语学分设置不同，使用本教材的学时也可以有所不同，但我们建议至少达到72课时，这样就可以根据教材编排一步步完成：首先是学习课文，完成所有练习；然后结合所学课文，开展项目研究。教学安排可根据不同目的有所侧重：1）若注重学术论文阅读教学，目的是帮助学生熟悉正式论文的结构，提高阅读英语学术论文和从论文中汲取信息的能力，建议把主要时间花在第一部分（即Critical Reading）的教学上。此部分都包括至少一篇学术论文、一篇与主题相关的讲座，以及跟这篇论文和讲座相关的听说读写练习。教师可适当选取和论文相关

的第二部分（即Academic Writing / Presentation）和第三部分（即Literacy Skills），进行讲解和练习。2）若注重学术论文写作教学，目的是通过学术论文写作的分析和练习，培养学生的英语论文写作的能力，建议把主要时间用在第二、三部分上。第一部分可以让学生在课下完成，教师将其作为学术论文写作教学的样例进行使用。

根据教材的设计，最理想的教学安排是在一学期内完成，每周4个课时，这样的学习和训练密度，才能取得更好的效果，保证教学目标的完成。

本课程的评估方法有两个：学生递交最终的课程成果，即一篇含有IMRD要素的小论文（见Appendix II）和以此为基础的学术报告展示（如论文海报，见第249页）；学生参加期末测验，检验是否有效掌握了学术英语技能和语言要求（测试样卷见Appendix I）。课程要求：学习约2000个新增学术英语词汇；半小时内基本读懂一篇6000词左右的专业文献，速度达到每分钟200词；掌握学术论文的写作方法，并能写出1500-2000词的小论文。

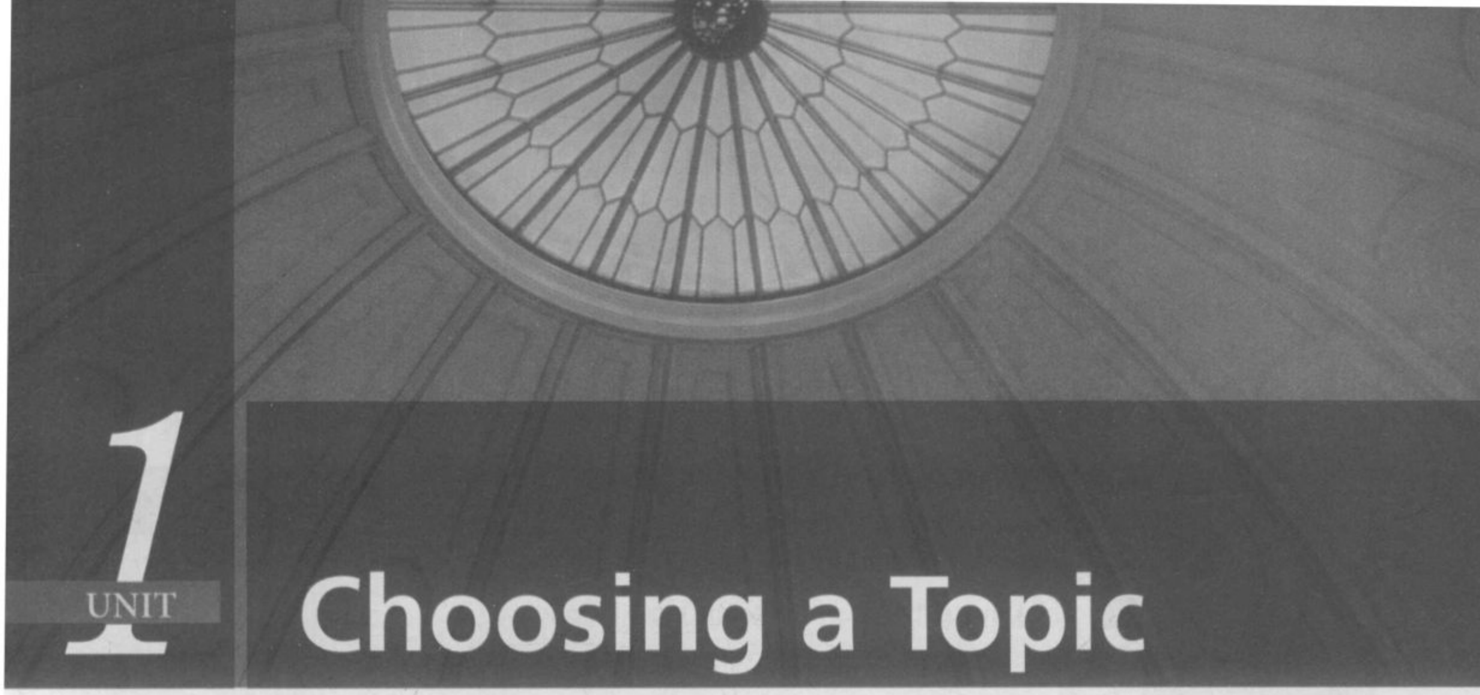
《学术英语 理工》自2012年出版以来，见证了我国高校学术英语教学规模由小到大的发展历程。三年多来，她历经风雨，度过严冬，得到了越来越多理工科院校和综合院校师生的认可。她的成长证明了《理工》的编写理念和定位是适合我国大学英语教学发展方向的。

教育部即将公布的《大学英语教学指南》（以下简称《指南》）首次把学术英语列入了大学英语教学内容，这也意味着学术英语的春天已经到来。等闲识得东风面，万紫千红总是春。在《指南》这股东风的吹拂下，学术英语教学已在全国越来越多的高校推广和开展。我国大学生，尤其是理工大学生，不少有着世界一流的创新思想。我们有义务为他们插上语言的翅膀，让他们展翅飞翔，冲向国际学术舞台。这就是本书的宗旨，这就是每一个学术英语教师的职责，这就是时代赋予当今大学英语教师的崇高使命。于此，我们特奉上第二版《理工》，以飨读者。

蔡基刚

2015.11

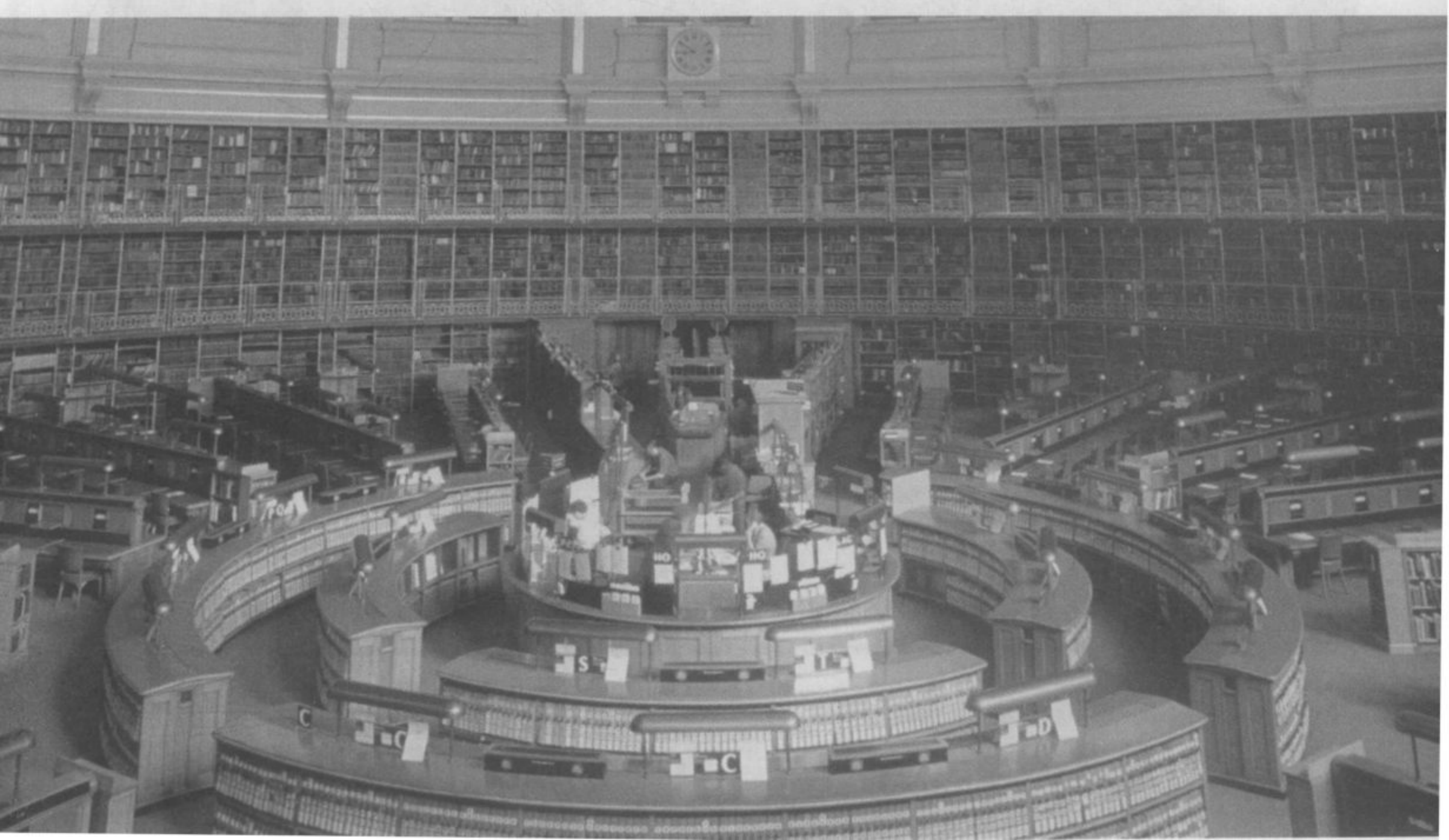
目录



UNIT 1 Choosing a Topic

In this unit, you will learn how to:

- ask probing questions in critical thinking;
- have a better understanding of basic elements of research papers;
- choose a particular topic for your research;
- formulate research questions;
- write a working title (暂定标题);
- avoid plagiarism;
- use citations;
- use sources by quoting and summarizing.



1 Critical Reading

Understanding the text

TASK 1 **Skim the text and complete the table below.**

Key words	
Objective	
Methods used	

Laypeople's Understanding of Radioactivity[1] and Radiation

E. K. Henriksen

1 radioactivity *n.* 放射性

Introduction

1 Since the discovery of X rays in 1895, ionising radiation[2] has been a part of our life and consciousness. From the very beginning, radiation has been shrouded in myths—of exaggerated expectations as well as excessive fear[(1)]. Radiation has been characterised partly as a life force, partly as a doomsday power destined to cause the ultimate destruction of mankind. In our own time, fear seems to be the prevalent characteristic of the public perception of radiation phenomena, and the treatment in the media of incidents like the Chernobyl accident[3] has greatly contributed to the spreading of uneasiness and fear.

2 Why should we expect the public to know something about radioactivity and radiation? There may be many answers to this question; three of the most evident are the following:

1) The pragmatic reason

People should be capable of protecting themselves from the harmful effects of radiation as well as avoiding excessive fear.

2) The democratic reason

People should be capable of informed judgments in political matters involving radiation phenomena, nuclear energy, waste disposal, exposure limits etc.

3) The educational reason

The individual derives pleasure and fulfilment from knowing something about the world around him / her.

3 How can knowledge about radiation phenomena be effectively communicated to laypeople? In the constructivist approach[4] to learning, the learner is viewed as actively creating his / her own understanding in an interaction between the notions he / she already holds and the input provided by external sources such as the teacher, peers or the mass media. Within this understanding of learning, the learner's ideas and conceptions prior to instruction are seen as important factors in the learning process. This principle also holds true in the field of radiation, and a number of publications have dealt with pupils' and laypeople's conceptions of radiation phenomena. For instance, Lijnse et al.[(2)] described concepts of radioactivity and radiation held by 15- and 16-year-old pupils in the Netherlands, and Eijkelhof and Millar[(3)] analysed British newspaper reports of the Chernobyl accident to identify features of the lay understanding of radiation phenomena.

4 The present survey was conducted to investigate the understanding of radiation phenomena and risk among Norwegians with a reasonable level of general education, but lacking specialisation in physical science.

2 ionising radiation 电离辐射

3 Chernobyl accident 切尔诺贝利核事故

4 constructivist approach 建构主义方法

Methods

Respondents

5 The survey was administered in the form of a questionnaire given to 270 students in an elementary physics course at the University of Oslo[5]. This group was chosen for two main reasons: 1) The group was fairly large and easily accessible; and 2) the group mainly consisted of first-year students who had completed secondary education, but had not received formal instruction on radiation since leaving school. This student group can in no way be said to represent the general public. Nonetheless, it can be assumed that the results are indicative of conceptions and attitudes found among those with a general, secondary education in the direction of natural sciences, but no specialisation.

6 Of the 270 students 191 (71%) completed the questionnaire. Of the respondents 53% were women, 45% were men and 2% did not state sex. It cannot be excluded that the 29% who did not respond differed from the respondents in relevant respects. Since this survey does not aim to establish percentages of persons holding this or that conception, but rather aims to identify a few commonly held conceptions of radiation phenomena among non-specialists, the possible bias from non-respondents should not render the results irrelevant.

The questionnaire

7 The questionnaire consisted of 13 questions. Two of these gave background information about gender and background in secondary school, seven measured knowledge and understanding of radioactivity and radiation, and four were designed to give information about radiation fear and attitudes. Most questions were connected to real-life examples that the students might know from the media coverage of current issues related to radiation. The questions which are referred to in the paper are presented in Table 1 on the next page.

Coding and analysis

8 The answers to the open-ended questions in most cases fell into one of 5-10 categories, defined after reading the answers from about 20% of the respondents. All answers were then assigned to the appropriate categories and coded.

9 To obtain a measure of each respondent's level of understanding, a point system was developed. Each of the questions concerning knowledge and understanding was appointed a maximum number of points, adjusted to the presumed difficulty of the question. For each question, points ranging from zero to maximum were awarded to respondents according to their degree of understanding as judged by the investigator.

---

5 Oslo 奥斯陆（挪威首都）

Table 1 Questions and point assignments

No.	Questions and Max No. of Points
1	(a) Are you afraid of being exposed to radiation in your daily life? *If yes:* (b) Where do you think this radiation comes from?
2	(a) Do you think there are radiation sources (radioactive substances[6]) in the house where you live? *If yes:* (b) Which ones?
3	Radiation from radioactive substances may be divided into three main types. (a) What are they called? (2 points) (b) What constitutes the radiation in each case? (4 points)
4	After the reactor accident in Chernobyl in 1986, radiation could be detected from a range of Norwegian foodstuffs, particularly mutton and reindeer[7] meat. How had the food become radioactive? (2 points)
5	After the Chernobyl accident, restrictions were imposed on the sale of mutton meat with radioactivity exceeding 600 Bq / kg. Radioactivity is measured in becquerel[8] (Bq). What is the definition of 1 Bq? (3 points)
6	The radioactive substance caesium-137[9], which was found in mutton after the Chernobyl accident, has a half-life[10] of 30 years. What is meant by this? (3 points)
7	Many types of spice are irradiated in order to kill bacteria. We say that the radiation is absorbed in the spice. What do you think happens in the spice when radiation is absorbed? (3 points)
8	What sorts of injuries can be found in the people who have been exposed to radiation from radioactive substances? (See below*)
9	In Sweden, more than half the electric energy is supplied by nuclear power. Do you think this should continue? Give a reason for your answer.
10	The Russian submarine *Komsomolets* sank near the island of Bjørnøya in 1989. Many people think that the sub should be raised. (a) Do you think that the *Komsomolets* is a threat to the environment in the northern seas? *If yes:* (b) In what way?

* *Points were awarded according to the number of radiation injuries mentioned; 1 point for each type of injury listed (when correct). Exception: 2 points were awarded for mentioning mutations[11] when these were explicitly connected with the initiation of cancer.*

6 radioactive substance 放射性物质
7 reindeer *n.* 驯鹿
8 becquerel 贝克（勒尔）（放射性活度单位）
9 caesium-137 铯-137（铯的放射性同位素，简写为^{137}Cs）
10 half-life *n.* 半衰期
11 mutation *n.* 突变

The sum of the points from all knowledge questions was taken as a measure of each respondent's level of understanding. The maximum number of points obtainable for each question is presented in Table 1. To find out whether the level of understanding influenced respondents' attitudes and level of radiation fear, the respondents were divided into two groups: those who scored lower than median on the knowledge questions (the low-score group), and those who scored higher than median (the high-score group). The data were analysed using SPSS[12] Version 6.1 for Windows. A significance level of 95% was applied.

Results and discussion

Knowledge of the radiation process

10 A major aim in the survey was to get an overview of the respondents' understanding of central concepts concerning radioactivity and radiation phenomena. From the answers to Question 3, it appeared that 89% of the respondents knew of the three radiation types (alpha[13], beta[14] and gamma[15]), whereas only 34% could correctly state what the radiation consisted of in each case. The definition of one becquerel (Question 5) was known to 25%. It should not be regarded as very alarming that most respondents were unable to define particular concepts such as the becquerel or α, β and γ radiation. These concise definitions are for expert use. More important, in view of the reasons for knowing stated in the introduction (the pragmatic, the democratic and the educational reason), is the lack of understanding of central features and processes related to radioactive decay and absorption of radiation.

11 A prevalent tendency among the respondents was the lack of differentiation between the concept of radioactive material and that of radiation, most apparent in the answers to Question 4:

> *"Radiation from the ruined reactor in Chernobyl had gone into the lichen on which the sheep and reindeer grazed."*

It has previously been observed that laypeople have difficulties distinguishing the concept of radiation from that of radioactive material[(2)(4)]. The difficulty is a serious obstacle to understanding the nature of radiation hazards and the appropriateness of countermeasures.

12 When asked about the concept of the half-life (Question 6), 74% of the respondents gave a definition which might be called correct. However, some of the acceptable answers might conceal a misunderstanding:

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12 SPSS (Statistical Product and Service Solutions) 统计产品与服务解决方案软件

13 alpha 希腊字母表中第一个字母 α

14 beta 希腊字母表中第二个字母 β

15 gamma 希腊字母表中第三个字母 γ

"It [a half-life of 30 years] means that it takes 30 years for 1 kg of ^{137}Cs to be reduced to 1/2 kg. The mass decreases because the substance gives away alpha irradiation, which is particles."

The answer betrays a lack of understanding that disintegration of a radioactive atom involves the creation of a new nucleus[16]. Many answers of the type "The amount of radioactive material is halved" might conceal a similar misunderstanding.

13 To find out if the respondents knew what was meant by "absorption of radiation", an example was used concerning the absorption of radiation in spice which is irradiated to kill bacteria (Question 7). The question appeared to be difficult—only 55% attempted an answer. Ten percent of the respondents answered that "the radiation is taken up by the spice", and some of these added that the radiation was "stored" in the spice, which gave reason to suspect that they really meant that the radiation made the spice radioactive. Twelve percent said explicitly that the radiation made the spice radioactive. This concept is probably a consequence of the lack of differentiation between radiation and radioactive material.

14 The survey also dealt with the radiation sources to which we are exposed in our daily lives and the health consequences of exposure to ionising radiation. When asked whether they believed that there were radiation sources in their home (Question 2), 62% answered in the affirmative. It appeared from the answers that there was considerable confusion concerning what a source of radiation is. Many seemed to regard this as an expression for almost any undesirable agent[17] in buildings: electric and magnetic fields[18], asbestos[19], toxic chemicals[20] in building materials etc. Confusion between sources of radiation and other environmental hazards has also been described in the literature. For instance, Durant et al.[(5)] found that almost 50% of the respondents in a survey of public understanding of science believed that nuclear power stations could cause acid rain.

15 The respondents had clear perceptions of the kinds of change that ionising radiation can cause to the human body, and a wide variety of answers was given to the question concerning this (Question 8). The most frequent answer was cancer (mentioned by 75%), whereas mutations were mentioned by 49% and genetic damage[21] by 36%. Other effects mentioned included birth defects, damage to cells and organs, death, sterility[22] or decreased reproductive capacity[23], skin damage, hair loss and burns. The results gave no information about the extent to which the respondents imagined these effects to appear (or after what kind of doses). It is worth mentioning that the most important effect, from an expert point of view, is cancer, presumed to be initiated by mutations. Genetic effects have so far been detectable in animal experiments, not in humans.

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16 nucleus *n.* 原子核
17 agent *n.* 能因；使然力
18 magnetic field 磁场
19 asbestos *n.* 石棉
20 toxic chemical 有毒化学品
21 genetic damage 基因损伤
22 sterility *n.* 不孕不育
23 reproductive capacity 生殖能力