

**EVIDENCE IS EVIDENCE:**  
**A CASE STUDY OF THE EFFECTIVE INTEGRATION OF**  
**VISUALS AND TEXT IN TEXTBOOKS**

by

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## **ABSTRACT**

This report explores how visuals can be used to facilitate learning and to enhance the educational value of textbooks. The report draws upon empirical research on the use of visuals in the fields of cognitive psychology and visual pedagogy, and applies this research to specific cases. In particular, the project considers the use of visuals in traditional textbooks and compares it with the one in the Wiley Visualizing series textbooks. The Wiley Visualizing program, a relatively new project by John Wiley & Sons, is based on the fundamental multimedia principle: information is more effective when presented in words and pictures than in words alone. Research, indeed, has shown that the brain processes information using both visual and auditory channels. Therefore, presenting information both visually and aurally facilitates the learning experience. In the Wiley Visualizing textbooks, visuals and text are purposely conceived and planned together to clarify major concepts, make the understanding easier, and facilitate retention.

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## INTRODUCTION

*“And you who wish to represent by words the form of man and all the aspects of his membrification, relinquish that idea. For the more minutely you describe the more you will confine the mind of the reader, and the more you will keep him from the knowledge of the thing described. And so it is necessary to draw and to describe.”*

— Leonardo da Vinci (quoted in Popova)

The world of educational publishing has gone through significant changes in the last few years, due to advancements in technology, new discoveries on the way human beings learn and make sense of information, and a targeted audience that has different demands and expectations. If twenty years ago textbooks were exclusively text-based and available in print format, current textbooks incorporate far more multimedia elements and are accessible across different platforms. Contemporary students have grown up using technology and consuming multimedia material and are therefore natural digital learners. Not only they are able to understand multimedia significantly more and better than previous generations, but they also prefer to be taught through a combination of different media rather than text alone.

The changes have taken place quickly. For thousands of years, words — both written and spoken — have been the major channel for instruction. Textbooks have been traditionally text-based and illustrations have been mostly used to “decorate” the text, as extras rather than elements with their own educational potential. Today, we are observing a shift toward “visual literacy” that the educational world, publishers included, cannot ignore. Our society is more and more visual and screen-based, and knowledge can and must be built up through various modalities (images, text, symbols, videos, abstract design, etc.). The

purpose of images is no longer to amplify, entertain, and illustrate, but to communicate and be meaning-makers. To produce valuable, useful, and enjoyable textbooks, educational publishers need to embrace the new available technologies and to engage in dialogue with researchers on how to produce enriched and effective textbooks. Since research shows that the academic success of students is largely dependent on their ability to read and understand textbooks (Kamil 2), an ongoing discussion among instructors, publishers, and researchers on the way to improve textbook material would result in substantial benefits for students.

This report explores how visuals can be used to facilitate learning and to enhance the educational value of textbooks. Empirical research on the use of visuals in the fields of cognitive psychology and visual pedagogy shows that information is more effective when presented in words and pictures than words alone. In particular, this paper considers the use of visuals in traditional textbooks and compares it with the one in the Wiley Visualizing series of textbooks. In that series, visuals and text are purposely conceived and planned together to clarify major concepts, make the understanding easier, and facilitate retention.

The first chapter of this paper briefly examines the history of John Wiley & Sons, its evolution from a small printing shop in Manhattan at the beginning of the nineteenth century into a multinational publishing company. This chapter also considers the challenges educational publishers are facing in the new digital environment and how John Wiley & Sons in particular is responding to the situation.

The second chapter describes the developmental editing process in textbook publishing. Publishing a textbook for the Canadian market is a long process that involves many steps and the collaboration of numerous people with different skills. This chapter focuses on how and when the artwork is planned and created during developmental editing. This is an essential point to understand how the



Wiley Visualizing textbooks differ from traditional ones. A section is dedicated to photographs, the most common kind of visual in textbooks.

The third chapter considers how visuals can be used to enhance the learning experience, focusing on the new concept of visual literacy, the empirical research on how well-designed text illustrations generally enhance learners' performance, and the Cognitive Theory of Multimedia Learning.

Finally, the fourth chapter considers the Wiley Visualizing series in detail. An explanation of how the project started and what it entails is followed by the six methods proposed by Wiley to improve the classroom experience, the Visualizing features contained in the Visualizing textbooks, and the effectiveness of and response of students and instructors to the Visualizing texts. In this chapter, practical examples from a recently published Visualizing textbook are provided.

Some of the information used in writing this report was collected in the period from June to September 2011, during which I interned with the Higher Education editorial department at John Wiley & Sons Canada. Additional information was obtained from books and journals, interviews conducted with the staff at both John Wiley & Sons Canada and the central office in Hoboken, NJ, internal materials provided by the staff, websites, and magazine and newspaper articles.

# CHAPTER ONE

## JOHN WILEY & SONS INC.

*“Wiley’s ability to navigate through the transitions of the next few years will depend on the very capabilities that have helped it survive over two centuries. [...] Assessing and managing risk has always been the publisher’s day-in, day-out companion, and over the past decade Wiley has developed effective tools for this purpose.”*

— Jacobson et al. 457

### 1.1 THE HISTORY

John Wiley and Sons Inc. started as a small printing shop in Lower Manhattan, founded in 1807 by Charles Wiley. In the early phase of book publishing in North America, it was common to combine printing, bookselling, and publishing in one enterprise. “Charles was a jack-of-all-trades, acquiring manuscripts, editing them, and even overseeing the typesetting and sales (Jacobson et al. 457).” Both Charles Wiley and his son John published a wide range of subjects, from *belles lettres* to engineering. In the second half of the century, John and his sons reinvented the business, dropping many fiction and non-fiction subjects and focusing on professional titles in science and technology. From that humble beginning, the company has grown and expanded its operations over two centuries to become one of the major educational publishing companies in North America. John Wiley and Sons Inc. has recently celebrated its bicentennial, which makes it a very old publishing company by North American standards. Still a family-owned company, Wiley is now a multinational publishing company with its headquarters in Hoboken, NJ, and more than twenty offices around the world (Jacobson et al. vii). The company has publishing, marketing, and distribution centres in the United States, Canada, Europe, Asia, and Australia. Moreover, in 2011 Wiley opened an office in Dubai

and began to consider expanding its presence in Brazil (John Wiley & Sons Inc. 2011 Annual Report 8). Wiley's statement of purpose reads as follows:

Wiley's mission is to be a global information and education company providing content and services to professionals, researchers, educators, students, lifelong learners, and consumers worldwide.

Wiley is dedicated to serving our customers' needs while generating attractive intellectual and financial rewards for all our stakeholders — authors, customers, clients, colleagues, and shareholders (John Wiley & Sons Inc. 2011 Annual Report 28).

Wiley is organized into three businesses: Global Education (or Higher Education); Professional/Reference; and Scientific, Technical, Medical, and Scholarly (STMS). The STMS is the largest of the three businesses and its products include journals, books, major reference works, databases, and laboratory manuals. One of the STMS most successful projects is the *Wiley Online Library*, which was launched in August 2010. The library is a multidisciplinary collection of online resources, over 4 million articles from journals, books, multi-volume reference works, laboratory protocols, and databases. The Professional/Reference business specializes in books, subscription content, and information services in different subject areas, including business, technology, health, cooking, psychology, and travel. One of its leading brands is the popular *For Dummies* reference series, started in 1991, which now has more than 250 million books in print and more than 1,800 titles ("About For Dummies"). Finally, the Global Education business publishes educational material for colleges, universities, for-profit career colleges, and advanced placement classes worldwide. The focus is on the sciences, engineering, mathematics, business/accounting, geography, computer science, statistics, education, culinary, hospitality, psychology, and modern languages.

Although Wiley is a multinational corporation, John Wiley & Sons Canada Ltd. is a relatively small company. The main office, which is based in Toronto, was opened in 1968. After a good start, the company encountered a tough time in

the 1980s, especially for the Higher Education department. Wiley Canada both imported and adapted US titles, but the exchange rate of the US dollar was unfavourable and price resistance very strong. However, during the 1990s Wiley Canada established its reputation as a leading publisher in the accounting textbook market. At the same time, the company decided to expand the publishing program beyond the business disciplines (Jacobson et al. 410-411). Nowadays Wiley Canada Higher Education publishes about sixteen textbooks per year, 80 percent of which are adaptations of US titles (Visentin, interview by author). Accounting has traditionally accounted for the bulk of titles, and it continues to grow, but over the last several years it has become a smaller percentage of the company's overall program. Other fields that Wiley Canada Higher Education publishes in include sciences, mathematics, psychology, and geography.

## *1.2 PUBLISHING IN THE DIGITAL ENVIRONMENT*

Considering the transition the publishing market is undergoing, Wiley, as with most publishing companies, has been devoting more focused attention to digital products. In 2011 the company has observed a considerable growth in the ebook channel, although this applies much more to other divisions than to Higher Education. In Higher Education, indeed, the trend has been more toward flexibility, with print at the centre but digital support for services such as self-study and assessment. Wiley expects much of its future growth to be driven by digital products, although it is not projecting a decline in print sales in the short term. The challenge is to create content that is more customizable and that can be accessed across multiple platforms in different formats. In Higher Education the two most successful and noteworthy projects in this category are *WileyPLUS* and *Wiley Custom Learning Solutions*.

*WileyPLUS* is an online teaching and learning environment that integrates textbook content with additional material and supports course-oriented activities, such as tutorials, self-quizzes, online planning, and homework. The

program has been at the centre of Wiley’s digital strategy and has received very positive feedback from both instructors and students. For the last year, Wiley has been partnering with Quality Matters to certify publisher-created online courses. The Quality Matters (QM) Program is a faculty-centered, peer review process designed to certify the quality of online courses and online components. *WileyPLUS* courses are certified using specific Quality Matters standards that verify the clarity and meaningfulness of design, learning objectives, assessment strategies, resources, and materials, as well as the level of student engagement (“Quality Matters”).

*Wiley Custom Learning Solutions* was launched in 1993 as *Wiley Custom Publishing Select* to respond to instructors’ need to customize course material. At the time, in fact, “students complained that they were paying for textbook content they never used, while instructors were looking for flexibility when selecting materials for a course (Jacobson et al. 353-354).” Some professors used to take selected material to shops, where it was copied and bound for sale to students. Other professors taught without textbooks, preferring to use their own instructional material. As a response to this situation, Wiley’s executive editor at the time decided to develop a system that allowed instructors to select chapters from different Wiley titles and add their own material if they wanted to. Wiley Custom is now a full-service custom publishing department that allows instructors to select and assemble Wiley content for various sources, which can be delivered in print or as an ebook.

## CHAPTER 2

### PLANNING THE ARTWORK DURING THE DEVELOPMENTAL EDITING PROCESS

*“If I could tell the story in words, I wouldn’t need to lug a camera.”*

— Lewis Hine (quoted in Sontag 185)

#### *2.1 DEVELOPMENTAL EDITING*

##### **“Developmental/Project Editing**

Co-ordinating and editing a project from proposal or rough manuscript to final manuscript, incorporating input from authors, consultants and reviewers. May include budgeting, hiring, design supervision and project co-ordination (“Definitions of Editorial Skills”).”

This definition by the Editors' Association of Canada provides an excellent explanation of what developmental editors do, although their responsibilities may vary depending on the publisher and the way individual editors work. In addition, because of the transition the publishing industry is currently going through, the role of developmental editors is changing. On the one hand, publishers tend to outsource more aspects of the book process, including developmental editing. On the other hand, developmental editors more and more are assigned tasks that are not strictly related to developmental editing.

In educational publishing it takes almost two years to develop a book from the original idea until publication. Since most textbooks become outdated after only three years, their lifetime is quite short. They date so quickly not only because frequent new developments in research require the text to be updated, but also because after the first edition has been in circulation for a while, students

know the solutions and professors prefer to use new textbooks. When the publisher decides to revise the book, it takes approximately a year to develop a new edition (Staudinger, interview by author).

At Wiley Canada Higher Education, the developmental process starts with a planning meeting with the author, which is led by the acquisitions editor although the developmental editor attends as well. During the meeting, the editors and the author discuss the schedule, the distribution of work, the key overall changes, and the changes needed by chapter if the book is a revision, or the structure for each chapter if it is a new book. In addition, they may consider the *WileyPLUS* structure and possibilities in the market, as well as discussing other supplements. In trade publishing, the process most often starts with a book proposal. In educational publishing, the publisher examines the list to see if there are any gaps and which sectors need to be covered. Acquisitions editors in particular spend a considerable amount of time talking to educators and instructors to understand what the specific needs are. If a new book is being planned, a proposal is created based on the needs identified by the acquisitions editor. The proposal is written by an author whom the acquisitions editor has approached – someone who teaches the course in question. If the proposal reviews well, the author proceeds to the actual writing. Once the first draft of the manuscript is ready, it is sent for review to a target list supplied by the acquisitions editor and Market Development. Usually four or five reviewers are contacted per chapter. The developmental editor coordinates the reviews. Reviewers are asked to rate the chapter, discuss strengths and weaknesses, provide suggestions for improvement, and say whether or not they would use it for their courses. If the book is an adaptation of an American book, they also express their opinion on the “Canadianization” of the book. In fact, adapting textbooks for the Canadian market involves more than changing the spelling from American English to Canadian English, the measurement systems, and the vocabulary. It also involves incorporating changes aimed at reflecting Canada’s culture and geography. For instance, stories or case studies featuring American companies or personalities are revised to feature Canadian equivalents.

Illustrations may be changed to show Canadian scenes, or to eliminate foreign flags or logos. However, the bulk of the work to be done in the adaptation consists of changes that reflect differences in curriculum. For instance, editors might decide to re-order, eliminate, combine, or add chapters, to expand the end-of-chapter material, or to add a new problem type. In fields like accounting, differences in laws or practices can necessitate substantial changes to the text.

Once the developmental editor receives the reviews, she summarizes and discusses them with the acquisitions editor; subsequently the acquisitions and developmental editors discuss them with the author. The developmental editor provides a sample chart of key requests made by reviewers, which helps the author when rewriting the problematic sections. Depending on the feedback received, the developmental editor may decide to send out some chapters for a second review. If the chapter reviews very poorly and the author has to make major changes, the chapter is sent out for another review; otherwise, it is ready for its final writing. Sometimes, when the editors deem it necessary, they consult with an advisory board. This means that a small group of instructors who teach the course the textbook is targeted to in the top universities meet with the author to discuss how the textbook can be improved. Another powerful tool is the student focus group, where students suggest changes and improvements to the textbook.

After this initial phase of reviews and market development, which takes about a year, the manuscript is prepared for layout. This includes the transmittal of documents, book plan, art log, and the preparation of a permissions log. If a text is very image-oriented, a freelancer is usually hired to manage permissions and photo research. Otherwise, the developmental editor takes care of this aspect, usually with the help of an editorial assistant. At the same time the manuscript is prepared for layout, the acquisitions and developmental editors, the media editor, and the editorial manager have a meeting to consider and plan supplements and media features. The *WileyPLUS* Account Managers are also invited to the meeting. The plan for supplements and media is generated by reviewing what the company has done in the past and what is available in other



courses, and by listing all the possibilities and ideas for group discussion. The participants in the meeting then consider what is needed, what is possible, and which reviewers expressed interest in working on the project. The production phase consists of tasks such as page corrections and checking of the proofs, which are usually handled by the developmental editor for major texts and outsourced to a full service provider for straightforward or smaller market texts. The developmental editor follows the progress being made and indicates when the text content is ready for XML conversion. Throughout the process, the production manager is in contact with the layout group regarding schedules and budgets.

## *2.2 PLANNING THE ARTWORK PROGRAM*

Developing a textbook is a long process that consists of different stages and is the result of the work of many people. Although textbooks are mainly text-based, illustrations may still constitute a significant part of the entire book, depending mainly on the subject. Accounting books, for example, tend to contain text for the most part, except for a few photographs or illustrations that accompany sidebars and text boxes. Geography textbooks, on the other hand, have a generous number of visuals, maps in particular. *The Chicago Manual of Style* defines artwork as “anything that is represented by means of an image rather than by the letters and other orthographic symbols that make up the text of a book or an article (112).” Typical illustrations in textbooks are photographs, drawings, diagrams, maps, and charts. They can also include combinations of text and illustration, such as reproductions of book covers or posters, or screenshots of a website page. Tables, despite their visual representation of information, are not considered artwork and they are typeset along with the text.

The preparation of the artwork comes quite late in the development process, usually when the final draft manuscript has already been submitted. Although this is the standard in the industry, it is a habit that can be self-defeating. First, planning the artwork so late in the process may delay the entire project, since the

book can't go to press until all visuals have been finalized and permissions for them cleared. Second, "the result is often an art program that looks like an afterthought—which it is (Norton 201)."

Although it may seem quite straightforward, the artwork program can be a time-consuming and laborious process. The visuals need to be chosen, which requires a considerable amount of research, and then the copyright holders must be contacted and permissions to use the images must be obtained. For heavily image-based textbooks the permissions process can last weeks or even months. Depending on the project, photo research/permissions can be done in-house or outsourced. If the textbook doesn't have many illustrations, the artwork is taken care of in-house, usually by an editorial assistant. However, if the textbook contains many illustrations, the editor usually hires a freelance consultant. Sometimes the editor may decide to outsource only some of the chapters and take care of the rest in-house.

The first step of the process is the art research. This may be the author's or the publisher's responsibility. In some cases, both of them decide on the artwork. The author may choose some illustrations while writing the text, especially if they will accompany a very technical passage in the text and choosing them requires a deep knowledge of the subject. In this case, the editor, or someone working on her behalf, searches for the more general images, usually photos from stock agencies. In other cases, the author is not willing or able to do the art research, so the publisher hires a freelancer to perform the task. This frequently happens in textbook publishing, where authors are often instructors at colleges or universities and don't have time to follow or participate in every step of book development.

Following the art research is the preparation of the art log, an Excel document that provides the typesetter with a list of all the images that appear in a chapter. The editor submits the art log when she sends the chapter file to be typeset. The art log contains information such as the image number, the page number, whether the image is new or a "pickup" from the US edition in case of an

adaptation, a brief description, and the kind of visual (photo or illustration). It is important to fill out the document accurately to avoid mistakes when the artwork is integrated into the chapter. During or after the preparation of the art log, the editor or photo researcher responsible for the artwork prepares the permissions log. This document, usually also created using Excel, lists all the visual material in the text coming from outside sources that the publisher has to request permission to use. The permissions log too needs to be very detailed and to provide as much information as possible about each image. Ideally, the document contains these details: image number (this information comes from the art log), brief description, whether the image is new or a “pickup,” source, contact information of the person responsible for granting permission, photo ID if the image comes from a stock agency, permission status, fee (if applicable), credit line, and additional notes. The permissions log needs to be updated on an ongoing basis, as the permissions process proceeds and the editor sends new chapters. It is important to start requesting permissions to use material as soon as possible, since it can take several weeks to get a response from some sources.

The most common sources of the artwork are government agencies, not-for-profit organizations, private companies, other publishers, and stock agencies. Occasionally material comes from websites or university libraries. The person responsible for permissions starts by contacting the sources that usually need more time to process requests, such as government agencies. Stock agencies are contacted last, since they are used to dealing with publishers and usually process requests promptly. Most permissions letters are usually sent by email and must contain specific information on the work the publisher wishes to reproduce, the publication in which the material will be used (title, authors, publication date, page number, print run, and list price), and the rights requested. In the case of new material, the publisher also needs to request a high-resolution digital file of the image, specifying the format, dimensions, and resolution desired. Sometimes the copyright owner asks to see the page containing the material. When an agreement is reached, the copyright owner is asked to sign a formal letter of agreement, and both parties will retain a signed copy.

From this description the permissions process may seem quite linear, but it can actually be challenging, especially when the textbook is a first edition or the permissions paperwork from the previous edition is not complete. One of the obstacles can be to find the original source of the material. Particularly when the image was found online, it can be hard to track down the copyright holder. Before the Internet, stock agencies provided editors with CDs showcasing their collections and accompanying books showing small images of the pictures that were on the CD. When editors decided to purchase an image, they called the stock agency and ordered it. Another way to find illustrations was to go to the library and consult their image archive. The choices were more limited compared to today's almost infinite options, but it was much clearer what the source of the material was (Staudinger, interview by author). Another situation that can make it difficult to obtain permission is a source that is not used to dealing with publishers or permissions requests. For instance, personnel with the source itself may have problems verifying who has the authority to grant permission. This usually happens when the source doesn't have a copyright or communications department, or when the source is a big company or organization with an intricate structure, so the request ends up being forwarded from one person to another. A company that does not usually deal with publishers also may not be able to locate the original high-resolution file. Problems can also arise when the permissions log from the previous edition contains incomplete or wrong information, such as incorrect credit lines or photo IDs. All of these possible scenarios show why it is important to update the permissions log on an ongoing basis and to fill it out with as many details as possible. Precise logs and well-organized permissions folders help to avoid confusion in the present and make the permissions work for the next edition easier and less time-consuming. Wiley is now moving to a global permissions database that should make it easier for editors to find the logs for prior works.

### *2.3 PHOTOGRAPHS AND STOCK AGENCIES*

Photographs are the illustrations used most often in textbooks, and since, in most cases, the sources are stock agencies and image archives, photos are also the kind of visual for which it is easiest to obtain permission. Stock agencies are professional companies that maintain very broad collections of imagery and footage and whose customers are mostly media, professionals in the creative industry, and corporate design and marketing departments. The first agencies resembling modern stock agencies started in the 1890s, and their practices were formalized in the 1920s with the rapid expansion of the magazine and advertising industries in Europe and North America (Lupton and Abbott 124-125). In the 1970s, stock agencies started to separate into agencies oriented toward advertising and news agencies specializing in documentary images. The following two decades saw the rapid expansion of stock photography, due to technological improvements and to the fact that magazines started to gradually eliminate in-house photographers and hired freelancers instead (Lupton and Abbott 128). Today the supply of images is almost limitless. At the same time, however, some people argue that the images look more and more alike. Indeed, while browsing different agencies' collections in search of a particular kind of image, it is not uncommon to find almost identical photos, in terms of subject, composition, general tone, and colour.

Textbook publishers have accounts with the major stock agencies, which allows them to purchase images at discounted prices. Moreover, if a specific image is needed, the account manager at the stock agency can assist with the photo research. In addition to more commercial and general stock agencies that provide images on a wide variety of subjects, such as Getty or Corbis, there are agencies that specialize in different subjects. All Canada Photos, for instance, is an agency in Sidney, BC, that works with Canada's best photographers and is the primary source for images on Canada's scenery, people, and places. Other examples include Custom Medical Stock Photo, specializing in medicine, science, and education; Newscom and AP Images, whose collections focus on historical and contemporary images; StockFood, which provides high-quality food photos;

and Lensmodern, which only represents fine art photographers. It is important for photo researchers to know what the different agencies can offer, especially when working on textbooks that require specific images, such as scientific texts.

In terms of rights, images can be rights-managed (RM) or royalty-free (RF). Rights-managed images are licensed for one-time usage and for the purpose specified in the licence. If publishers want to use the image for other purposes, they need to repurchase it. Some rights-managed images are available with exclusive rights, which means that no one else can buy the image and use it in a similar way. Royalty-free images are priced according to the dimension and resolution required and, once purchased, can be used multiple times for multiple projects. For this reason, publishers tend to prefer purchasing RF images, since they can be reused in future editions or in other textbooks without having to repurchase them or arrange permission again. On the other hand, RM images are often of better quality, so it is sometimes worth investing in them.

## CHAPTER 3

### USING VISUALS TO IMPROVE LEARNING

*“Evidence that bears on questions of any complexity typically involves multiple forms of discourse. Evidence is evidence, whether words, numbers, images, diagrams, still or moving. The intellectual tasks remain constant regardless of the mode of evidence: to understand and to reason about the materials at hand, and to appraise their quality, relevance, and integrity.”*

— Edward Tufte, *Beautiful Evidence* vi

#### *3.1 CHALLENGES IN EDUCATIONAL PUBLISHING*

Over thousands of years, the purpose of textbooks has been to contain informational material and make it accessible and comprehensible to learners in order to educate them. To better serve this purpose and facilitate students' experience and learning, educational publishers need to embrace new technologies that allow them to offer a wider range of choices, to invest in research and adopt it to produce better textbooks, and in general to be flexible in meeting the needs of an audience that is in constant change. Textbooks have gone through significant transformations in the last years. Most publishers produce their textbooks in both print and digital forms and provide links to websites that offer additional resources. Researchers and publishing professionals underline that higher education publishers need to be aware of how students interact and respond to different media and how there should be more communication between researchers and publishers. Apple has recently shaken the educational publishing world announcing iBooks Textbooks, iPad-based textbooks that, according to Apple, will be more engaging than paper texts. In fact, these textbooks will offer features such as easy highlighting and note-taking, interactive photo galleries, videos, 3-D models and diagrams, immediate feedback with

questionnaires at the end of chapters, and the automatic creation of flash cards of glossary terms for students to study (Olivarez-Giles). Three major educational publishers, McGraw-Hill, Pearson, and Houghton Mifflin Harcourt, which together comprise 90 percent of the US textbook publishing world, have already signed on as the first content partners. However, publishers who want to take advantage of the platform have to sign an exclusivity contract with Apple, and sell textbooks at \$14.99 or less. Although this is an incredibly low price compared to the cover price of traditional paper textbooks, students still need to buy the iPad. Considering the power a company like Apple has and the fact that it is already collaborating with major publishers, this is likely to be a significant revolution in textbook publishing.

### *3.2 A NEW KIND OF LITERACY*

The educational world has been traditionally dominated by the print discourse and by the separation between text and pictures. Paradoxically, this distinction was not present in the first forms of books, but was encouraged by the invention of printing. For instance, illuminated manuscripts – handwritten manuscripts that circulated from AD 400 throughout the Middle Ages and the Renaissance in different parts of the world – were the result of the work of both scribes and illustrators and combined words and images to provide meaning. With the invention of printing, text and illustrations started to be separated in the production process, since the text was generally set up by the compositor, while the woodcuts were produced by an artist. From that moment on, the supremacy of text over pictures began to be established. Art started to be seen only as illustration, and to be added to a book later in the production process. Books were written first, and afterward an artist was employed to produce images to accompany the text. In some ways, the process persists, and for many contemporary books, the artwork comes when the first draft of the book has already been written. This practice has reinforced the cultural belief that pictures are less important than text (Russell 214). It is a prejudice that is not exclusive to



the educational field. Prosser laments how in anthropology the ability of media other than text to convey abstract ideas has for years been distrusted:

The general message, perhaps unwittingly, is that: films, videos and photographs are acceptable only as means to record data or as illustration and subservient to that of the central narrative; they are unacceptable as a way of 'knowing' because they distort that which they claim to illuminate (99).

In his book *Beautiful Evidence*, Tufte provides historical and contemporary examples of how images and words can be combined to deliver information.



**Figure 1:** Ninth-century illustration of a centaur.

In this ninth-century illustration of a centaur (Figure 1), for instance, we see how text and image are perfectly unified and words are even used to outline the centaur’s body. Tufte also highlights how the *Centaur* exemplifies the universality of images: while the Latin text is incomprehensible to most people, “today we easily grasp the visual meaning of this centaur drawn 1200 years ago (*Beautiful Evidence* 85).”

In Francisco Colonna's *Hypnerotomachia Poliphili* (Venice, 1499), words and images follow each other closely.

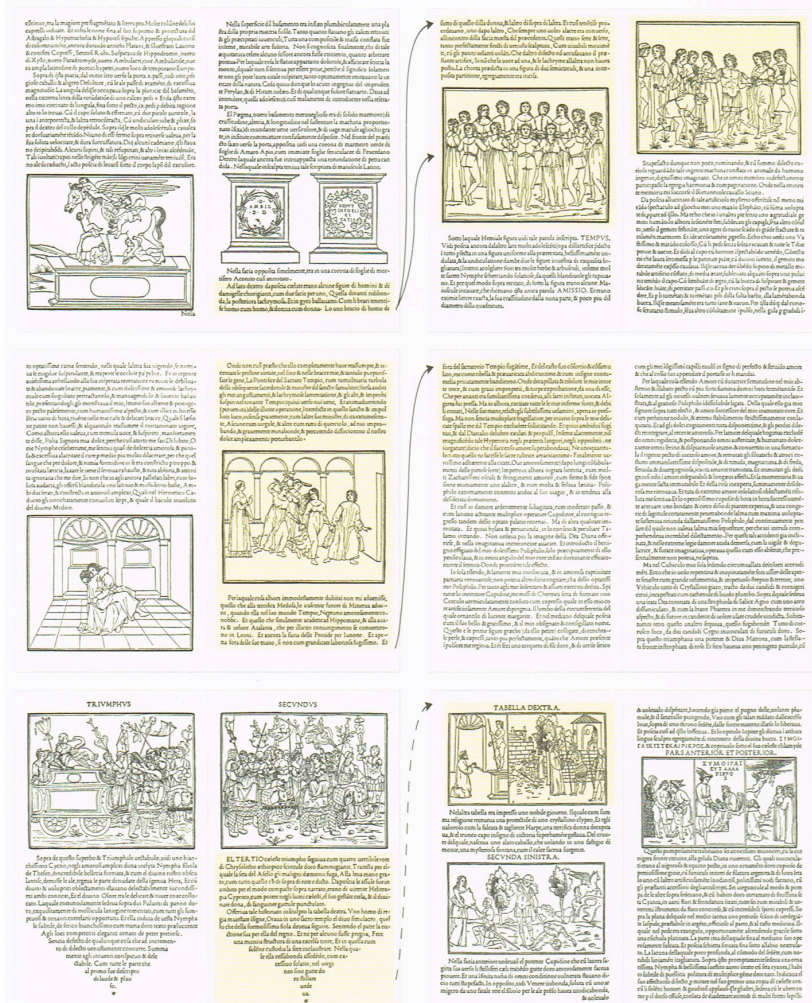


Figure 2: Pages reproduced from *Hypnerotomachia*, 1499.

Tufts observes that 73 percent of the woodcuts in the book have all their relevant words within the same double-page spread (Figure 2). Sometimes text and images are unified not only on the same spread, but also on the same page. What is important about the design of the *Hypnerotomachia* is that text and images are integrated not only optically but also cognitively (Beautiful Evidence 90-91). Later in his book, Tufts notes how Galileo, in his books and journals, makes no distinction among words, images, and diagrams, as they are all



considered scientific evidence. “The similar treatment of text, diagrams, and images suggests to readers that images are as relevant and credible as words and diagrams (Beautiful Evidence 109).” Finally, a more recent example from *Birds of North America: A Guide to Field Identification* shows how images and text can complement each other and provide information that would be incomplete without either one or the other.



**Figure 3:** Pages reproduced from *Birds of North America: A Guide to Field Identification* (New York, 1966), 208-209.

In Figure 3 the images of the birds complement and visually exemplify the text, and allow readers to compare the birds' appearances. The location maps convey additional information regarding where these birds live and can be observed (Beautiful Evidence 115).

The notion of the supremacy of words over illustrations is gradually disappearing, thanks to the emergence of new technologies and to recent discoveries on how the human brain works when assimilating instructional material. This new scenario has forced the educational world to rethink the concept of literacy and to adapt teaching material and methods accordingly. Word-based textbooks are being replaced by textbooks in which words and pictures are integrated to facilitate learning and which are accompanied by multimedia features. The first point to be made is that today's students live in a digital environment and use a variety of electronic devices every day. In a world that is becoming more and more visual and screen-based, the new generations are "digital natives," meaning that they are intuitively more visually literate and able to understand and use visual communication than previous generations (Felten 60). This cultural change calls for a new definition of literacy, one that includes visual communication and skills. As Ferfen writes, "visual literacy involves the ability to understand, produce, and use culturally significant images, objects, and visible actions (60)." This means that images do not only exist to illustrate words but produce meaning on their own, and that looking at pictures is not a passive process, but on the contrary requires the active construction of meaning. If knowledge can be built up not only through words, but also images and multimedia features, the approach to images in educational publishing needs to change. Visuals need to be considered earlier in the developmental process and to be selected accurately to avoid conveying wrong messages.

### *3.3 DIFFERENT METHODS FOR DIFFERENT LEARNERS*

The previous examples from Tufte's book show how images and text can be combined in books to enhance the reader's experience. But images in textbooks can also facilitate learning. Research conducted in different fields demonstrates that carefully selected text illustrations can enhance students' performance and assist them in learning. The underlying belief is that there are different learning styles and that each student has a preferred one. When students are taught using

a learning style that matches the one that works for them, they are more likely to learn. Research also shows that approximately 40 percent of college students are visual learners, meaning that they remember best when they see, and they prefer to be taught through pictures, diagrams, flow charts, timelines, films, and demonstrations. While 40 percent of the students were found to be visual learners, 74 percent reported a positive experience with their use of visual summaries. When they were asked why they liked the visual summaries, they answered that they could “‘see’ relationships, ‘organize’ the material, and quickly ‘review’ the entire class discussion (Irvine et al. 224).” Other studies on the role pictures play in children’s storybooks show how pictures may help to establish the setting, define/develop the characters, extend/develop the plot, provide a different viewpoint, contribute to the text’s coherence, and reinforce the text. Moreover, they can motivate the reader, promote creativity and children’s language and literacy, serve as mental scaffolds, and foster aesthetic appreciation (Carney and Levin 6). As a guide to creating visuals for texts, Levin and Mayer propose seven “C” principles to explain how pictures can enhance the text. They suggest that pictures can make the text more concentrated, compact/concise, concrete, coherent, comprehensible, correspondent, and codable (Carney and Levin 9).

### *3.4 THE COGNITIVE THEORY OF MULTIMEDIA LEARNING*

In addition to the idea that humans have different learning styles, research supports the assumption that to be effective, educational messages, such as textbooks, should reflect the human cognitive architecture. The operation of making sense of new information always requires an effort by the learner, which is called “cognitive load.” This obviously also applies to students who are reading and trying to understand a textbook. Part of the cognitive load is originated by the natural complexity of the instructional message. This is called “intrinsic cognitive load” and depends on the degree of element interactivity. The higher the element interactivity, the higher the intrinsic cognitive load. Another kind of

cognitive load, “extraneous cognitive load,” is originated instead by how the message is designed. Cognitive loads can be positive or negative. Whenever students are reading and trying to understand educational material, they build mental models that help them grasp and assimilate the material. This is an example of positive cognitive load. When the instructional message’s design is poor or doesn’t reflect the student’s mental model, or when visuals and text do not correspond, the result is a negative cognitive load (Leavitt). Good instructional messages reduce extraneous cognitive load, thereby increasing germane cognitive load.

Have you ever read a paragraph or a page in a book, stopped, and said to yourself: “I don’t remember one thing I just read?” This may happen when your working memory has been overloaded, and the text you read was not successfully integrated into long-term memory. Visuals don’t automatically solve the problem of overload, but well-designed visuals can reduce the number of elements that working memory must process, thus aiding learning (Berg et al. v).

When learners build mental representations from both words and pictures, multimedia learning occurs. Since its core is the simple combination of words and pictures, multimedia learning is not a modern phenomenon and does not require sophisticated technology. The addition of images to texts has a long tradition in the history of publishing and in the Western educational world. However, a theory of multimedia learning has been developed only in recent years. The case for multimedia learning is based on the assumption that people can learn more deeply from words and pictures than from words alone (Mayer, *The Cambridge Handbook of Multimedia Learning* 31).

As previously stated, effective educational messages reflect the way the human mind works. Because humans have two information-processing systems, one for verbal material and one for visual material, multimedia messages take full advantage of the human brain’s ability to process information. The benefit of combining words and images is not only quantitative, meaning that more

material can be presented on two channels than on one, but also qualitative, because visual and text materials can complement one another, enhancing the educational value of the message (Mayer, *The Cambridge Handbook of Multimedia Learning* 4-5). In fact, words and images serve different purposes. Descriptive representations, such as text, mathematical expressions, and formulas are more powerful when used to express abstract concepts. Schnotz provides an illuminating example:

It is no problem to say a sentence like “*The Marsh Harrier feeds on mammals or reptiles,*” which connects abstract concepts (e.g., *mammals, reptiles*), by a disjunctive *or*. In a depictive representation it is only possible to show a specific mammal (e.g., a mouse) or a specific reptile (e.g., a lizard). The disjunctive *or* cannot be represented by only one picture. It requires a series of pictures (e.g., one picture showing the bird eating a mouse and another picture showing the bird eating the lizard) (Schnotz, *The Cambridge Handbook of Multimedia Learning* 53).

On the other hand, representations such as photographs, maps, drawings, and line graphs are depictive representations. Schnotz describes a depictive representation as a “form of representation that uses iconic signs (such as visual pictures) to show characteristics of a subject matter (Schnotz, *The Cambridge Handbook of Multimedia Learning* 67).” Because they provide many details and are full of information, depictive representations are more useful to draw references. As Norton writes, “language has the advantage of appealing to all our senses with concrete detail and adding nuance of thought. But photographs can convey a visual immediacy and particularity that words cannot match, and line drawings can evoke meaningful patterns from raw data (204).”

While there is consensus on the importance of integrating text and visuals, not all visuals are equally effective. Visuals need to be well designed and carefully constructed with an eye to how learners will incorporate them into mental models. Schnotz examines the principles to follow to achieve visuals with high



educational value. Students learn better if words and pictures are semantically related (coherence condition) and if they are presented closely together in space and time (contiguity condition) (The Cambridge Handbook of Multimedia Learning 61).

### 3.5 CATEGORIZING VISUALS

An effective practical way to create highly educational visuals is to categorize them based on their pedagogical value. Richard E. Mayer, professor of psychology at the University of California, Santa Barbara (UCSB), and adviser on the Wiley Visualizing Series, identifies four types of graphics (Multimedia Learning 65):

1. Decorational
2. Representational
3. Organizational
4. Explanative

The four kinds of visuals are explained below, along with practical examples from the textbook *Nutrition: Science and Applications, Canadian Edition* by Smolin et al., published in January 2012.

1. **Decorational visuals** are, as their name suggest, purely decorative. They are used for aesthetic appeal or entertainment, or to stimulate interest, but have no instructional potential.

# 1

## Nutrition:

### FOOD FOR HEALTH

#### Case Study

Kaitlyn knew the potato chips in the dorm vending machine weren't a good choice—but aside from candy, they were her only option. Kaitlyn had been in classes and at work until late in the evening. When she finally sat down to study, she realized that she had missed dinner. She needed to eat something to keep her going until she finished the first chapter of her nutrition textbook, but her residence offered few food choices late at night. So she opted for the chips and fruit punch from the vending machine—they seemed to be the healthiest choices available.

As a first-year university student who has never been away from home, Kaitlyn has gained a few pounds and is beginning to be concerned about her weight. Her father recently had cardiac bypass surgery, and her mother takes medication for high blood pressure. Kaitlyn knows that because of this family history, her diet is a particularly important part of her future health. The residence cafeteria, although not great, does offer a variety of choices. The problem is that Kaitlyn doesn't know how to choose a healthy diet. She tries to keep some healthy snacks in her room, but her options are limited because she doesn't have a refrigerator. Several of her friends have started taking supplements like Mega B to give them more energy and ginkgo biloba to improve their memory. Kaitlyn is tempted to start taking them herself but remembers that her high school soccer coach told her that some supplements can be dangerous. To optimize her health, then, Kaitlyn needs to learn the basics of nutrition science and perfect the art of making nutritionally sound decisions and healthy food choices—a goal that is a little overwhelming at first.

By reading the first chapter of her nutrition textbook, Kaitlyn will begin to understand how to achieve this goal, as will you as you read along with her.



(PhotoAlto/Sigrid Olsson/Getty Images, Inc.)

**Figure 4:** Page reproduced from *Nutrition: Science and Applications, Canadian Edition* (Etobicoke, ON: John Wiley & Sons Canada, Ltd., 2012), 2.

In Figure 4 we see the case study at the beginning of chapter 1, “Nutrition: Food for Health.” The photo of a young woman studying accompanies the narrative about a first-year university student who is trying to make healthy nutritional choices while attending classes during the day and working until late in the evening. Although the photo is visually appealing and contributes to the layout of the page, it is purely decorative and doesn’t have any instructional value.

**2. Representational visuals** illustrate or overlap the text content, usually portraying a single part of the information contained in the text. They are the type of images most commonly used in textbooks. Although their educational potential is minimal, if not nonexistent, they can have a recall advantage,

meaning that students may be able to better remember a text that is accompanied by a representational visual.

few weeks or months can cause nerve damage. Most nutrient toxicities are due to excessive intakes of vitamin and mineral supplements. Foods generally do not contain high enough concentrations of nutrients to cause toxic reactions.

The kinds of overnutrition that are most common in the Canada today do not have immediate toxic effects but contribute to the development of chronic diseases, such as heart disease, type-2 diabetes and some types of cancer, in the long term. Diets providing more energy than needed have resulted in a Canadian population where 60% of adults are overweight or obese (Figure 1.7b).<sup>4</sup> Diets high in salt contribute to high blood pressure, those high in saturated fat and cholesterol play a role in heart disease, and those high in red meats and saturated fats and low in fruits and vegetables and fibre may increase the risk of colon cancer.<sup>5</sup>

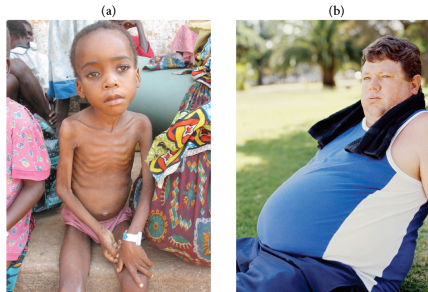


Figure 1.7 Malnutrition includes both undernutrition (a) and overnutrition (b). (Tom Koene/Peter Arnold, Inc.; Stockbyte/Getty Images, Inc.)

**genes** Units of a larger molecule called DNA that are responsible for inherited traits.

#### Diet–Gene Interactions

Diet affects your health, but diet alone does not determine whether you will develop a particular disease. Each of us inherits a unique combination of **genes**. Genes are composed of DNA which contain the information that a cell needs to synthesize specific protein. Some of these genes affect your risk of developing chronic diseases such as heart disease, cancer, high blood pressure, and diabetes, but their impact is affected by what you eat (Figure 1.8). Your genetic makeup determines the impact a certain nutrient will have on you. For example, some people inherit a combination of genes that results in a tendency to have high blood pressure, possibly because the proteins produced by these genes are less effective in excreting sodium. When

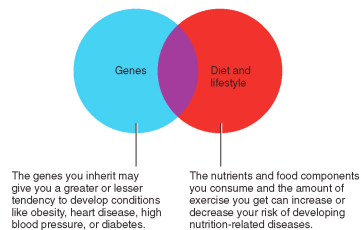


Figure 1.8 Diet and genes  
Your actual risk of disease results from the interplay between the genes you inherit and the diet and lifestyle choices you make.

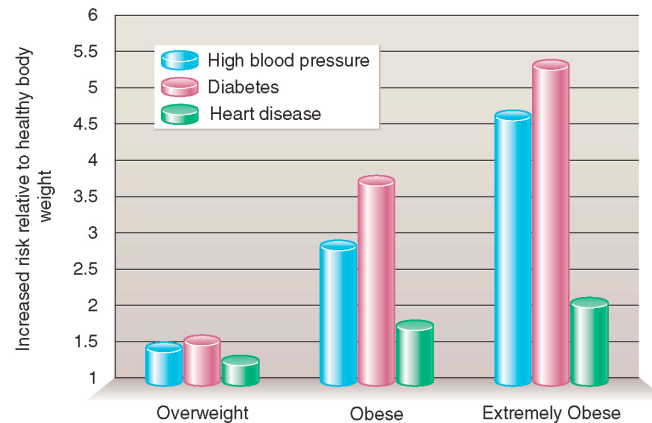
**Figure 5:** Page reproduced from *Nutrition: Science and Applications, Canadian Edition* (Etobicoke, ON: John Wiley & Sons Canada, Ltd., 2012), 12.

These two photos, again from chapter 1, “Nutrition: Food for Health,” accompany a paragraph on undernutrition and overnutrition. Although these images visually illustrate the paragraph content and can be useful to facilitate retention, they simply depict the text and do not have a high educational value.

**3. Organizational visuals** display relations, structures, or organization among parts of a whole, providing a framework for the text to be understood. Their educational value is high because they help students build mental models.



In addition, the presence of these diseases increases the risk of illness and premature death that is associated with being obese. Obesity also increases the incidence and severity of infectious disease and has been linked to poor wound healing and surgical complications.<sup>13</sup> The magnitude of the health risks increases as the amount of excess fat rises (Figure 7.13).



**Figure 7.13 Excess body fat and disease risk among Canadians**

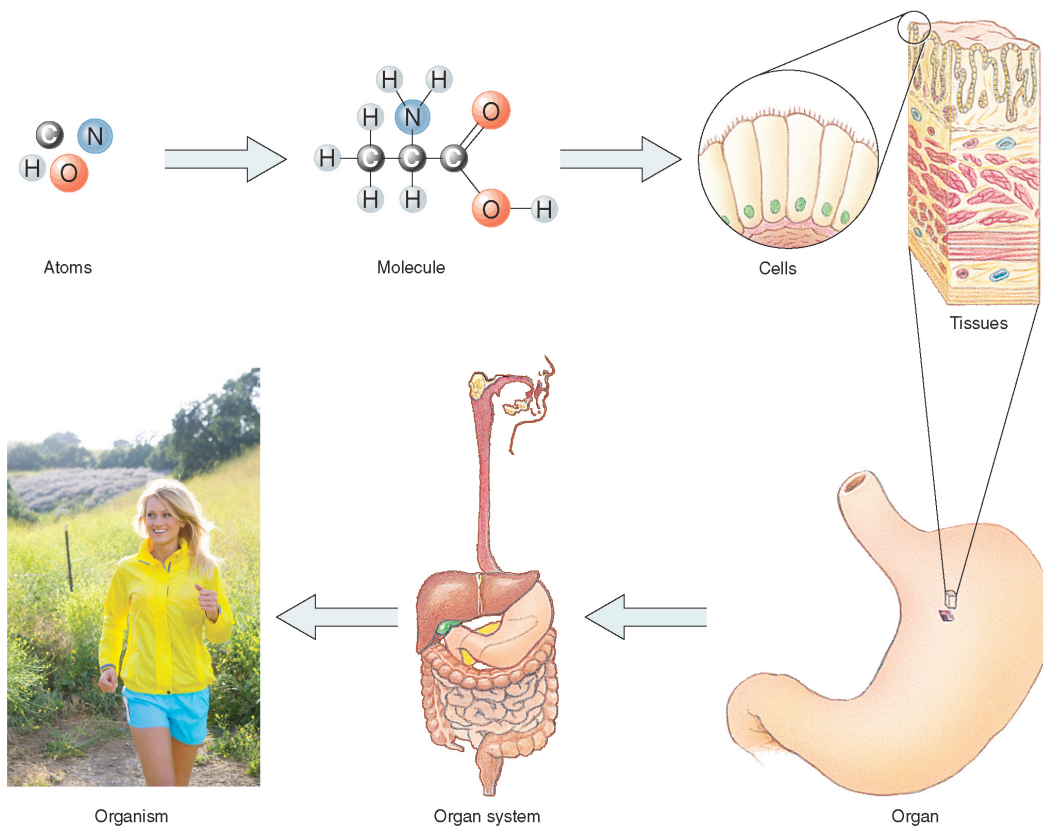
The more excess body fat an individual carries, the greater the risk of a number of chronic diseases. A value of 1.0 represents the risk of having these disorders if your weight is in the healthy range; a value of 2 indicates that the risk is doubled.

**Source:** Statistics Canada. Nutrition: Findings from the Canadian Community Health Survey. Measured Obesity: Adult Obesity in Canada: Measured Height and Weight: 2005. Available online at <http://www.statcan.gc.ca/pub/82-620-m/2005001/article/adults-adultes/8060-eng.htm#5>. Accessed July 12, 2010.

**Figure 6:** Page reproduced from *Nutrition: Science and Applications, Canadian Edition* (Etobicoke, ON: John Wiley & Sons Canada, Ltd., 2012), 276.

This graph in chapter 7, “Energy Balance and Weight Management,” displays the correlation between health risks and the amount of excess fat. Organizational visuals like the one in Figure 6 are extremely useful because they help students understand and remember the cause/effect relationship between variables.

4. Finally, **explanative visuals** explain how processes or cause/effect sequences work. As organizational visuals, they also help students make sense of information and build mental models and have a high pedagogical usefulness.



**Figure 3.1 Organization of life**  
 The organization of life begins with atoms that form molecules, which are then organized into cells to form tissues, organs, organ systems, and whole organisms. (Photo: Fuse/Getty Images, Inc.)

**Figure 7:** Page reproduced from *Nutrition: Science and Applications, Canadian Edition* (Etobicoke, ON: John Wiley & Sons Canada, Ltd., 2012), 86.

This illustration from chapter 3, “Digestion, Absorption, and Metabolism,” explains the organization of life by combining illustrations, text, and photos. The arrows show how the process begins with atoms that form molecules, which are then organized into cells to form tissues, organs, organ systems, and whole organisms. This visual has high instructional potential because it explains a complex process, helping students understand and build an effective mental model.

Because in traditional textbooks the visuals are usually chosen after the text has been created, they are not always selected on the basis of their intrinsic educational potential. The result is often images that are a combination of the

four kinds of visuals described above. Although decorative and representational visuals can provide a break from a block of text and may have a recall advantage, they don't add any instructional value to the text. Therefore, organizational and explicative visuals should be preferred. The Wiley Visualizing textbooks, described in the next chapter, differ from traditional textbooks because their visuals are closely examined and chosen based on the educational value.

## CHAPTER 4

### THE WILEY VISUALIZING SERIES

*“To envision information – and what bright and splendid visions can result – is to work at the intersection of image, word, number, art.”*

– Tufte, *Envisioning Information* 9

#### 4.1 A RECENT PROJECT

The Wiley Visualizing series, a recent Wiley project, started in the United States, where John Wiley & Sons published the first Wiley Visualizing book in 2006. Since then the company has published second and third editions of Visualizing books in different subjects. The project started as a partnership with National Geographic Society, which, having a wide collection of beautiful photos, provided the visuals used in the textbooks. In 2011 the partnership was not renewed and it is likely that Wiley will find another partner for the project (Tripmacher, interview by author).

The Wiley Visualizing texts differ from other textbooks in that they try to combine text and visuals in a way that facilitates learning, retention, and student involvement. They are based on the research conducted in fields like visual learning and pedagogy that proves that students benefit from the right combination of text and visuals. In particular, Wiley Visualizing uses the Cognitive Theory of Multimedia Learning discussed in section 3.4 to select visuals that specifically support students' thinking and learning.

Although at a first sight the Visualizing textbooks may seem like traditional textbooks with incredibly beautiful images, the research methodology is different, as well as the way the books are conceived and developed. Whereas in traditional book publishing the text is created first and then the visuals are added later, the

basic concept of the Wiley Visualizing texts is to have the images drive the text. This different approach has a profound impact on the developmental editing process. Because the aim of the series is to include only organizational and explanative visuals, avoiding decorative and representational images – unless they work as part of a multi-part graphic and add value to the visual – authors and editors develop the visual list prior to writing the manuscript.

Mayer suggests developing the visual list starting from the topic outline and brainstorming what images would best convey the topics (“Developing Visuals for the Wiley Visual Imprint”). This should be a free-thinking exercise through which authors and editors list all images that come to mind. The second step is to determine whether each visual has instructional value and to decide how it will be used. Authors and editors then closely examine each visual on the list and determine what type it is, using the categorization method described in section 3.5. They select the visuals on the basis of their instructional value, excluding any that do not have such value. By this method, the publisher is able to design, produce, and add images to the text that are visually interesting and appealing, as well as being driven by content. An additional step in the developmental editing process is the creation of a book map, a document that the developmental editor has to submit at transmittal. The book map differs from the art log used for traditional books because it shows the placement of all of the visuals and is meant to be a guide for the designer/typesetter who composes the pages. This document needs to be created by someone who is very familiar with the content, as the goal is to ensure that the placement of the images has the greatest possible educational impact. Its preparation can be quite time-consuming, which is why it is considered an additional step in the Visualizing schedule (Staudinger, email message to author).

#### *4.2 SIX METHODS TO IMPROVE THE CLASSROOM EXPERIENCE*

Well-designed visuals enhance the textbook and the reading experience, and can also be used by instructors in the classroom to make the learning experience



as meaningful and effective as possible. Below are the six ways in which Wiley proposes to use the Wiley Visualizing visuals in the classroom (“Wiley Visualizing Pedagogy”).

1. Assign students to study visuals in addition to reading the text.

Instructors should make sure that students understand that the visuals are as important as the text. If students have not been taught to consider the visuals as important instructional material, they may not pay enough attention to them. The visual material provides a concrete visual representation of the textual information and can help students make sense of abstract concepts.

2. Use visuals during class discussions or presentations.

Instructors should point out important information as the students look at the visuals. This method helps students focus on key visual elements, organize the information, and develop an integrated mental model. The method is effective only if instructors select visuals that organize and explain key concepts rather than simply depicting them. Moreover, since the oral explanation will provide students with the verbal information they need, visual presentations should not contain too much text, or students may be overwhelmed with too much information.

3. Use visuals during reviews.

Students can review key vocabulary, concepts, principles, processes, and relationships displayed visually. This method is particularly helpful in recalling vocabulary and physical relationships.

4. Use visuals for assignments and when assessing learning.

Visuals can be used for comprehension activities and assessments. For example, students can be asked to identify examples of concepts portrayed in visuals. Visuals can be used to stimulate higher-level thinking and for activities that require deductive and inductive reasoning, drawing references, and problem solving.

5. Use visuals to situate learning in authentic contexts.

Learning is more substantial and effective when the learner can apply facts, concepts, and principles to realistic situations or examples. For instance, visuals of familiar objects can be used to explain new, unfamiliar details about those objects.

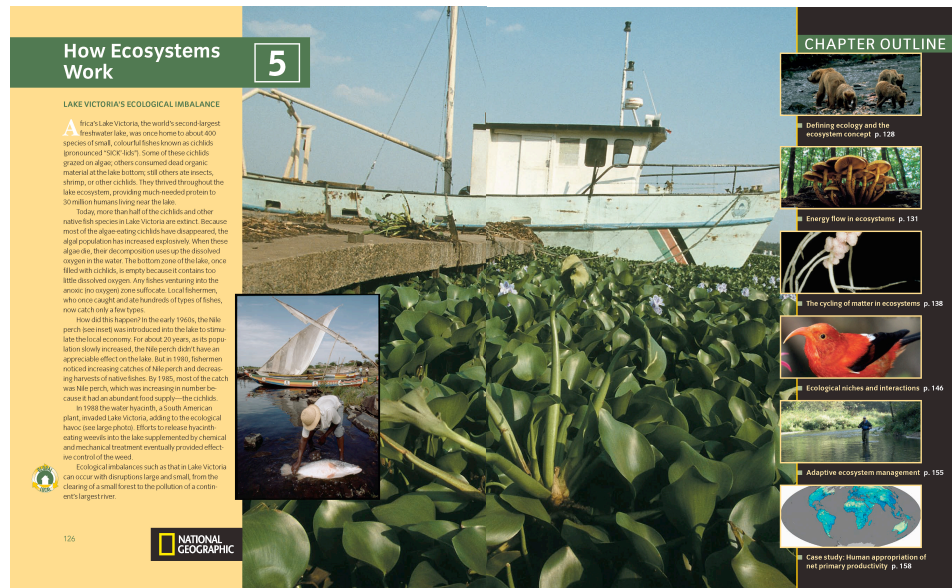
6. Use visuals to encourage collaborative meaning making.

Students are often required to take part in collaborative activities. Visuals can be used as the centrepiece of these activities, requiring students to study, make sense of, discuss, hypothesize, and make decisions regarding the content of the visual. This method encourages collaboration since students need to work together to interpret and describe the visual.

#### 4.3 THE VISUALIZING FEATURES

The Visualizing textbooks include many features that incorporate visuals. Each title has two to four of these features included in each chapter. The features are explained below, with the addition of examples from *Visualizing the Environment, Canadian Edition*.

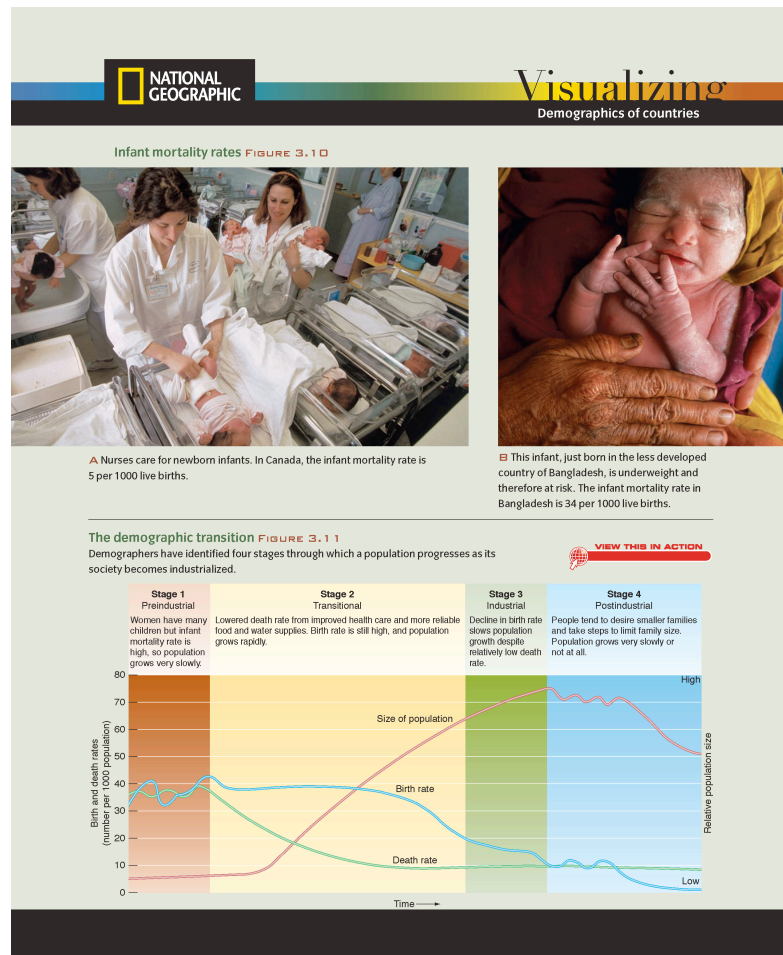
- **Chapter introductions:** They provide concise stories about some of today's most pressing issues concerning the chapter topic. The narrative is accompanied by striking photographs and a **chapter outline** that visually summarizes chapter content using thumbnails of illustrations from the chapter.



**Figure 8:** Pages reproduced from *Visualizing the Environment, Canadian Edition* (Etobicoke, ON: John Wiley & Sons Canada, 2010), 126-27.

In Figure 8 we see the chapter introduction and outline of chapter 5, “How Ecosystems Work,” which features a story on Lake Victoria in Africa. The lake was once populated by fish known as cichlids, which are now extinct. Because these fish consumed algae, their extinction caused the proliferation of the algal population. The fishermen, who once caught a wide variety of fish, now catch only a few. The photographs accompanying the narrative show a local fisherman and the lake covered in algae. Not only are the photographs beautiful, but also they provide a concrete visual illustration of the story and help students retain the information. On the right is the chapter outline, which summarizes the main points covered in the chapter.

- **Visualizing features:** This feature is titled appropriately for the specific discipline and consists of a visual spread on a particular subject that combines photos, figures, and other visuals as appropriate with text.

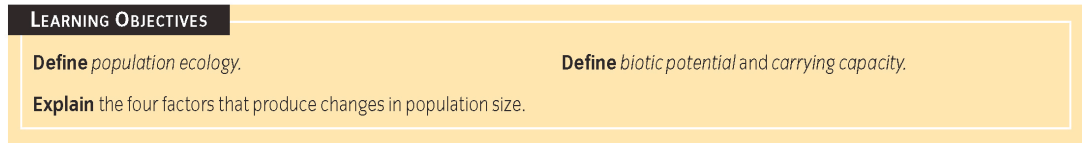


**Figure 9:** Page reproduced from *Visualizing the Environment, Canadian Edition* (Etobicoke, ON: John Wiley & Sons Canada, 2010), 80.

This Visualizing feature, which is part of chapter 3, “Human Populations,” focuses on the demographics of countries. The two images show and compare a newborn in a developed country, Canada, and a newborn in an underdeveloped one, Bangladesh. The graph shows the birth and death rates in the four different stages through which a society becomes industrialized. The feature provides a useful insight and helps students to make cause/effect connections.

- **Learning objectives:** Placed at the beginning of each section, they indicate what students should be able to do to demonstrate they have mastered the material in the chapter.

## Population Ecology



**LEARNING OBJECTIVES**

**Define** *population ecology.*

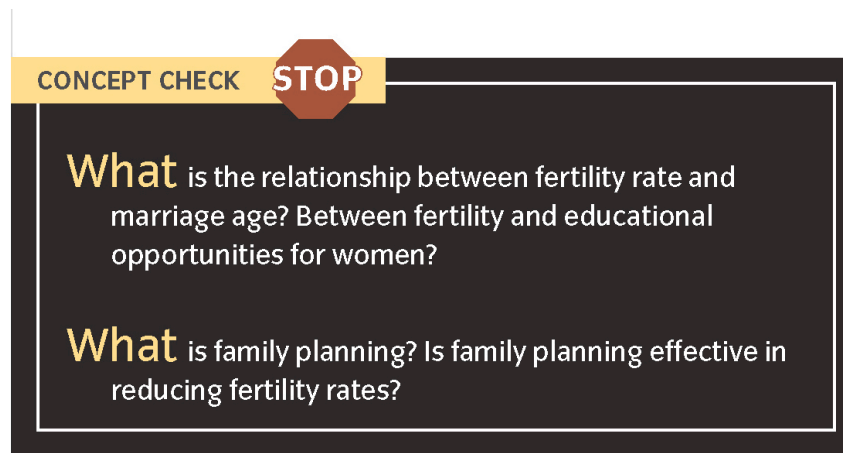
**Define** *biotic potential and carrying capacity.*

**Explain** the four factors that produce changes in population size.

**Figure 10:** Page reproduced from *Visualizing the Environment, Canadian Edition* (Etobicoke, ON: John Wiley & Sons Canada, 2010), 68.

This example shows the learning objectives for chapter 3, “Human Populations.”

- **Concept check:** This feature consists of questions at the end of the chapter that give students the opportunity to test their understanding of the learning objectives.



**CONCEPT CHECK** **STOP**

**What** is the relationship between fertility rate and marriage age? Between fertility and educational opportunities for women?

**What** is family planning? Is family planning effective in reducing fertility rates?

**Figure 11:** Page reproduced from *Visualizing the Environment, Canadian Edition* (Etobicoke, ON: John Wiley & Sons Canada, 2010), 88.

Chapter 3 focuses on population ecology, human population patterns and demographics, urbanization, and methods to stabilize the world population. This end-of-chapter concept check box invites students to correlate different information and to test their comprehension of chapter content.

- **Marginal glossary terms:** This box introduces the chapter’s most important terms, enhancing students’ retention.

### THE GAP BETWEEN RICH AND POOR COUNTRIES

**highly developed countries** Countries with complex industrialized bases, low rates of population growth, and high per person incomes.

**moderately developed countries** Countries with medium levels of industrialization and per person incomes lower than those of highly developed countries.

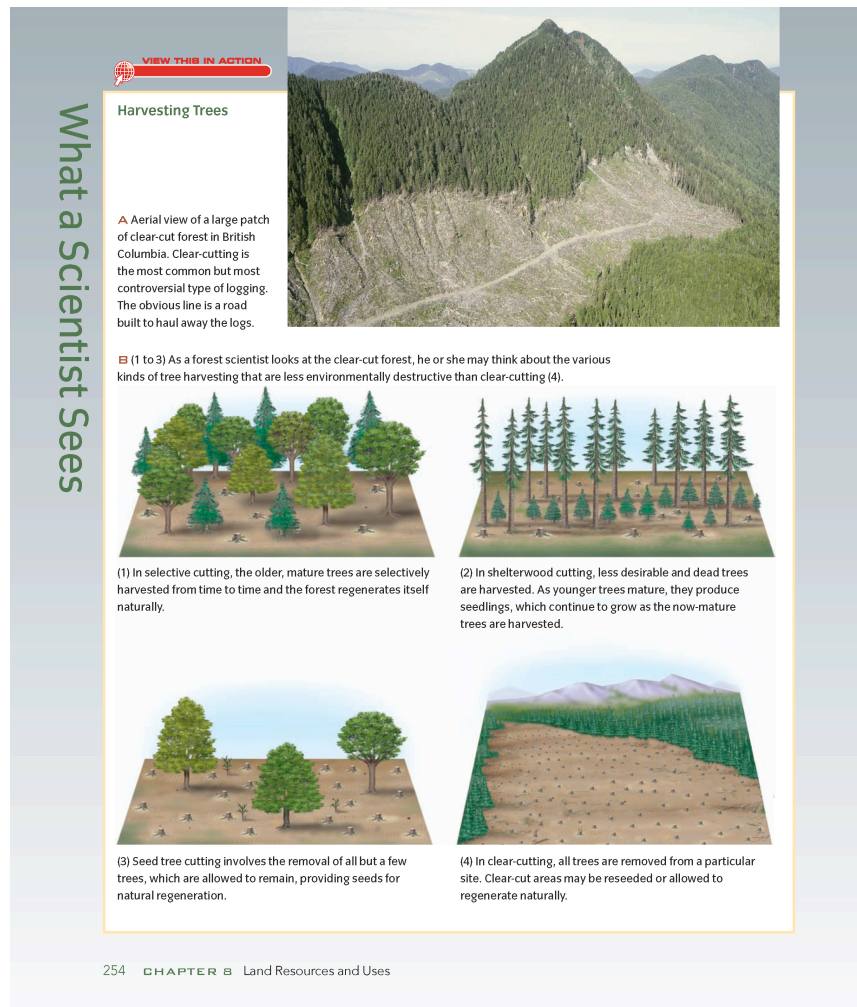
Generally speaking, countries are divided into rich (the “haves”) and poor (the “have-nots”). Rich countries are known as **highly developed countries**. Canada, the United States, Japan, and most of Europe, which represent about 20 percent of the world’s population, are highly developed countries (**FIGURE 1.4A**).

Poor countries, in which about 80 percent of the world’s population live, fall into two subcategories: moderately developed and less developed. Mexico, Turkey, South Africa, and Thailand are examples of **moderately developed**

**Figure 12:** Page reproduced from *Visualizing the Environment, Canadian Edition* (Etobicoke, ON: John Wiley & Sons Canada, 2010), 6.

This section on the gap between rich and poor countries, in chapter 1, “The Environment,” includes two glossary terms (green boxes at the margins). The glossary terms help students identify the key words in the chapter. In addition, as students continue reading the textbook, they can always go back to get an exact definition of the term if they need reminding.

- **What a Scientist Sees:** This feature highlights a concept or phenomenon using photos and illustrations that would stand out to a professional in the field. In this way students can develop observational skills.



**Figure 13:** Page reproduced from *Visualizing the Environment, Canadian Edition* (Etobicoke, ON: John Wiley & Sons Canada, 2010), 254.

This feature in chapter 8, “Land Resources and Uses,” visually shows different kinds of harvesting, from more to less environmentally destructive. The illustrations help students recognize the differences among the different types of loggings.



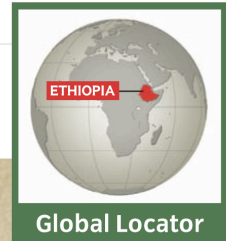




- **Global Locator Maps:** These maps locate the place or area being discussed on the globe, helping students develop their geographic skills.

**Gender discrimination** FIGURE 3.18

Ethiopia is traditionally a male-dominated society in which women and girls have a lower status than men. These young girls are attending an elementary school. Overall, only 17 percent of Ethiopian girls have access to a secondary education, as compared with 28.3 percent of boys.



**Figure 15:** Page reproduced from *Visualizing the Environment, Canadian Edition* (Etobicoke, ON: John Wiley & Sons Canada, 2010), 86.

This photo of students in an Ethiopian school accompanies a paragraph on the social and economic status of women in different parts of the world in chapter 3, “Human Populations.” The caption explains that Ethiopia is a traditionally male-dominated society and gives some statistics. The global locator helps students remember Ethiopia’s geographical position.

- **Case Study:** These illustrated cases are visual in-depth looks at a particular topic of interest that elaborates or expands on the text. They

provide students with a greater understanding of a key topic within the chapter.

**CASE STUDY**



**JAKARTA, INDONESIA**

**T**here is an urgent need to improve the environment and quality of life in cities, particularly in rapidly growing cities of developing countries. Consider Jakarta, Indonesia, which had a population of 16.9 million in 2006 and has continued to grow since then. (This number includes several nearby cities that have merged with Jakarta.)

Jakarta is plagued with many of the problems found in other rapidly growing cities in the developing world. The air in Jakarta is badly polluted with the exhaust from cars, buses, and motorbikes that transport about two million commuters into the city each day. Water pollution is also a critical problem. At least 95 percent of human wastes produced in the city are not cleaned up at sewage treatment plants. Instead, human sewage and garbage are dumped directly into nearby rivers. Jakarta's municipal water supply is so polluted that piped water must be boiled before people can drink it.

As groundwater has been depleted to meet the city's needs, parts of Jakarta have subsided so that many areas are increasingly flood prone, particularly during the rainy season (see photograph). Illegal squatter settlements proliferate; the poorest inhabitants build dwellings on vacant land using whatever materials they can scavenge. As in other cities around the world, in Jakarta, squatter settlements have the worst water, sewage, and solid waste problems.

Although we have painted a grim picture of Jakarta, it should be noted that improvements are slowly beginning to occur. As part of an ambitious long-term transportation upgrade, Jakarta has developed a busway with dedicated bus lines that reduce commuter times and encourage people to commute by bus rather than by automobile. A monorail and subway system are also planned.



Global Locator

Poorly constructed houses lining a canal in Jakarta

Case Study 61


**Figure 16:** Page reproduced from *Visualizing the Environment, Canadian Edition* (Etobicoke, ON: John Wiley & Sons Canada, 2010), 61.

This case study in chapter 2, “Environmental History, Jurisdictional Authority, and Sustainability,” focuses on Jakarta, Indonesia, a city that is heileaguered with some of the typical problems of rapidly growing cities, such as air and water pollution and illegal squatter settlements. A photo of poorly constructed houses in Jakarta accompanies the text. The case study provides students with a concrete example of some of the topics examined in the chapter.

- **What's Happening in this Picture?** This end-of-chapter feature presents students with an uncaptioned photo related to the subject of the chapter but illustrating a situation students have not encountered previously. The photograph is accompanied by a series of questions that ask the student to describe and explain what they can observe in the photo based on what they have learned. The aim is to stimulate creative thinking.

**What is happening in this picture ?**

- At Zoo Atlanta in the United States, an actor playing an African park guard and a volunteer teach children about ivory poaching.
- What are the goals of this effort?
- Which conservation law bans hunting elephants for their ivory?
- Do you think displaying elephants in zoos helps or hurts the species? Why?



Critical and Creative Thinking Questions 231


**Figure 17:** Page reproduced from *Visualizing the Environment, Canadian Edition* (Etobicoke, ON: John Wiley & Sons Canada, 2010), 231.

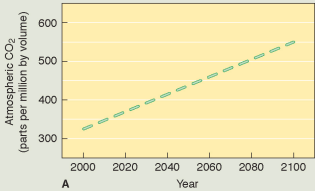
The photograph, taken at the Zoo Atlanta in the United States, shows an actor playing an African park guard and a volunteer teach children about ivory poaching. The questions at the side stimulate students to think about the matter creatively, since the particular situation represented in the photo has not been examined in the chapter.

- **Critical and Creative Thinking Questions:** The questions are meant to encourage critical thinking and highlight each chapter's important concepts and applications.

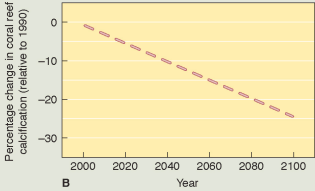
**CRITICAL AND CREATIVE THINKING QUESTIONS**

- Describe how the North American Wildlife Conservation Model came about. How did this model impact Canadian wildlife?
- What are some of the accomplishments achieved by the environmental legislation established in the last quarter of the 20th century? Take a moment to think about the current level of environmental protection that exists in Canada. Is this level of protection suitable? What are some of the challenges that still exist with environmental protection?
- What is the message of this cartoon? What environmental issue probably inspired it, and when was it likely published?
 


- What social groups generally suffer the most from environmental pollution and degradation? What social groups generally benefit from this situation?
- In its broadest sense, how does environmental justice relate to highly developed countries and less developed countries?
- What is the role of education in changing personal attitudes and practices that affect the environment?
- State whether each of the following statements reflects the Western worldview, the deep ecology worldview, or both. Explain your answers.
  - Species exist to be used by humans.
  - All organisms, humans included, are interconnected and interdependent.
  - There is a unity between humans and nature.
  - Humans are a superior species capable of dominating other organisms.
  - Humans should protect the environment.
  - Nature should be used, not preserved.
  - Economic growth will help Earth manage an expanding human population.
  - Humans have the right to modify the environment to benefit society.
  - All forms of life are intrinsically valuable and therefore have the right to exist.
- Write a paragraph that briefly describes your environmental worldview.
- Write a one-page essay describing what kind of world you want to leave for your children.
- The graphs below show a computer simulation by the U.S. National Climate Assessment. In the first graph (top), the level of atmospheric CO<sub>2</sub> is projected for the 21st century. As a result of increasing levels of CO<sub>2</sub> in the atmosphere, more CO<sub>2</sub> dissolves in ocean water, where it forms carbonic acid. The increasing acidity dissolves and weakens coral skeletons, which are composed of calcium carbonate (shown in the bottom graph). (Values in parts A and B are midrange projections.)
 



**A**



**B**

  - Why could rising CO<sub>2</sub> levels in the atmosphere be catastrophic to corals and other shell-forming organisms?
  - How do these graphs relate to Figure 2.20 (page 59)?
- Many conservationists today think that human health and well-being should be an important part of conservation efforts. Explain why humans and the natural world are interconnected, using tropical rainforests and indigenous people as an example.
- Are an improved standard of living and a reduction in the level of consumption mutually exclusive? Give an example that supports your answer.

**Figure 18:** Page reproduced from *Visualizing the Environment, Canadian Edition* (Etobicoke, ON: John Wiley & Sons Canada, 2010), 64.

This is an example of the end-of-chapter questions. Illustrations and graphs may accompany the questions to help stimulate students' critical and creative thinking.



- **Tables and Graphs:** They provide data at the end of the chapter, summarizing and organizing important information.

The world's 10 largest cities* TABLE 3.1		
1975	2005	2015
Tokyo, Japan, 26.6	Tokyo, Japan, 35.2	Tokyo, Japan, 35.5
New York, U.S. 15.9	Mexico City, Mexico, 19.4	Mumbai (Bombay), India, 21.9
Mexico City, Mexico, 10.7	New York, U.S. 18.7	Mexico City, Mexico, 21.6
Osaka-Kobe, Japan, 9.8	São Paulo, Brazil, 18.3	São Paulo, Brazil, 20.5
São Paulo, Brazil, 9.6	Mumbai (Bombay), India, 18.2	New York, U.S. 19.9
Los Angeles, U.S., 8.9	Delhi, India, 15.0	Delhi, India, 18.6
Buenos Aires, Argentina, 8.7	Shanghai, China, 14.5	Shanghai, China, 17.2
Paris, France, 8.6	Kolkata (Calcutta), India, 14.3	Kolkata (Calcutta), India, 17.0
Kolkata (Calcutta), India, 7.9	Jakarta, Indonesia, 13.2	Dhaka, Bangladesh, 16.8
Moscow, Russian Federation, 7.6	Buenos Aires, Argentina, 12.6	Jakarta, Indonesia, 16.8

\*Population in millions.

- Highly developed countries
- Developing countries

**Figure 19:** Page reproduced from *Visualizing the Environment, Canadian Edition* (Etobicoke, ON: John Wiley & Sons Canada, 2010), 93.

This table is part of a paragraph on urbanization trends in chapter 3, “Human Populations.” The table provides data on the world’s largest cities in 1975, 2005, and 2015. The visual presentation of numerical data helps students not only to memorize the information more easily, but also to draw comparisons.

In addition to general features that are used in all *Visualizing* textbooks, there are more subject-specific features. For instance, the Canadian edition of *Visualizing the Environment* includes the following features:

- **A “Global to Local” icon:** This feature appears at the margin of the text to reinforce the idea that environmental science covers issues from the local to the global scale.

The environmental problems and issues considered in this book are serious ones that society must address into the future. But we are not simply providing a “doom and gloom” listing of problems, coupled with predictions of a bleak future. On the contrary, the focus of environmental science and studies, and our focus as individuals and as world citizens, is on identifying,

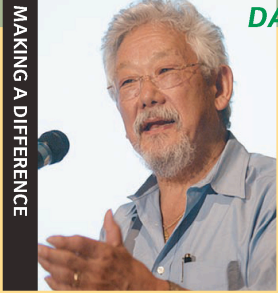


**Figure 20:** Page reproduced from *Visualizing the Environment, Canadian Edition* (Etobicoke, ON: John Wiley & Sons Canada, 2010), 25.

In this example the icon is placed at the margin of a paragraph on the goals for environmental investigations. The “Global to Local” icon reinforces the concept that the goal of environmental sciences is to identify both global problems and problems that individuals as a society have generated.

- **Making a Difference:** This feature highlights a Canadian person or organization that is working to promote environmental sustainability or contributing through research in the field.

MAKING A DIFFERENCE



DAVID SUZUKI

There are many advocates of environmental sustainability out there, but few have had the impact that David Suzuki has had and continues to have on influencing individuals, businesses, and governments to make sustainability a priority. A world-renowned scientist, environmentalist, and broadcaster, Suzuki has been educating the public on nature and the environment for over 40 years. His unique ability to communicate complex scientific concepts to the public in a clear and engaging manner has made his contributions to environmental education and conservation both in Canada and around the world matched by few.

In 1990, he co-founded the David Suzuki Foundation, a non-profit organization committed to educating and researching sustainable ways to protect nature's diversity and to working toward a balance between human needs and the Earth's ability to sustain life. Suzuki has authored over 40 books and has created several television series (*A Planet for the Taking*, *The Secret of Life*, and *The Brain*), each winning critical acclaim. Over and above these accomplishments, Suzuki is well known as the host of *The Nature of Things*, the scientific television program produced by the Canadian Broadcasting Corporation (CBC), and for his long-running CBC radio series *Quirks and Quarks*. Suzuki is the winner of numerous awards, including the prestigious Tory Peterson Memorial Medal from Harvard University, a UNESCO prize for science, a United Nations Environment Programme medal, and an induction as a Companion of the Order of Canada.

Suzuki's outspoken passion and commitment to addressing serious environmental concerns have brought forth social and political awareness and change. His contributions have placed Canada on the world stage in scientific leadership and have positioned him as a recognized world leader in sustainable ecology.

For more information on David Suzuki and the David Suzuki Foundation, please go to [www.davidsuzuki.org](http://www.davidsuzuki.org).

**Figure 21:** Page reproduced from *Visualizing the Environment, Canadian Edition* (Etobicoke, ON: John Wiley & Sons Canada, 2010), 14.

- This “Making a Difference” box in chapter 1, “The Environment,” features David Suzuki, a Canadian who has for years educated the public on nature and the environment. The box contains a brief biography and explains how Suzuki has contributed to social and political awareness and change.
- **Eco Canada Career Focus:** This feature at the end of each chapter highlights careers available to students in the environmental field. These features have been developed in conjunction with ECO Canada, a not-for-profit organization that supports Canada’s environment industry (“ECO Canada”).



**Figure 22:** Page reproduced from *Visualizing the Environment, Canadian Edition* (Etobicoke, ON: John Wiley & Sons Canada, 2010), 95.

This feature in chapter 3, “Human Populations,” focuses on the career of urban planning, explaining what the position entails and what kinds of projects an urban planner may undertake. The feature provides an insight

into the professional world, which is particularly useful to students who have limited work experience. Eco Canada Career Focus features' goal is to help students decide which career to pursue.

#### *4.4 THE EFFECTIVENESS OF THE WILEY VISUALIZING SERIES*

Response to the Wiley Visualizing texts has so far been very positive. In 2009, SEG Research conducted a study designed to evaluate the effectiveness of Wiley Visualizing. The study compared the growth in student content knowledge and skills of students in classes using Wiley Visualizing and a comparable group of students who did not use Wiley Visualizing. The result was that the students who used Wiley Visualizing performed better than the students in the other group. Specifically, students using Wiley Visualizing did 20 to 25 percent better on the post-test (“A Study of the Effectiveness of the Wiley Visualizing Series”).

Both students and professors have responded very positively to the Visualizing textbooks. For example, professor Ozeas Costa of the Ohio State University at Mansfield, who teaches an Earth Sciences course, integrates between 1200 and 1300 images from Visualizing Geology into his PowerPoint slides.

I would rather have the concept in pictures, images and graphics because they tell things that can't be said or written. That's why I selected this book—it offers many things that are visual. One of my favorite features of Visualizing is the process diagram—it is remarkable how these well designed diagrams help improve [students'] understanding of processes that are very complex to explain, such as the nebula hypothesis or the behavior of seismic waves in Earth's interior. — Ozeas Costa (“Wiley Visualizing Success Stories”)

From the students' perspective, the Visualizing textbooks are helpful because the visuals make the reading easier and more enjoyable, provide relief



from blocks of text, and seem to bring “the material to life.” Duane Hampton of Western Michigan University collected feedback from 196 students using Visualizing Geology in his Earth Science class over a year and a half. He also reported that student performance on exams has improved noticeably since he adopted the Visualizing Geology textbook, mostly because more students actually read more of the textbook. As one student said, “I really enjoyed the reading. The stop signs in the chapter provided questions that were important to understanding the chapter. The pictures were a nice break-up of the text, and provided interesting information (“Wiley Visualizing Success Stories”).”

## CONCLUSION

The use of multimedia material in educational texts is not a new phenomenon. Illustrations have been added to text since the first textbooks appeared. As society and education progressed, however, text and illustrations started to be seen as separate, and illustrations in particular to be regarded as mere visual decorations or depictions of the text that added aesthetic appeal but no educational value. Research conducted since the 1970s, however, has shown that visuals can have high instructional value.

Empirical research proves that to enhance learning, visuals need to be carefully selected during the preparation of a textbook. While all educational publishers make use of many illustrations in their books, not all of them pay attention to how visuals can actually contribute to the educational value of the textbook. The conventional process of preparing a traditional textbook – text comes first and visuals are “plugged in” later – is still the norm, and it is an editorial practice that can result in missed learning opportunities for students. Two main reasons can be identified.

First, although research on how visuals can improve learning has been available for decades, there has been little communication between the worlds of research and publishing. Research conducted primarily during the 1970s and 1980s supported the assertion that carefully constructed text illustrations generally enhance learners’ performance, and research conducted throughout the 1990s strongly supports that assertion. During the 1990s the field of multimedia learning emerged as a coherent discipline. *The Cambridge Handbook of Multimedia Learning*, published in 2005, was the first handbook to comprehensively cover the research and theory in the field. Whereas other publications on multimedia learning offered recommendations or described best practices, the book was based on empirical research and grounded in cognitive theory. The focus of the *Handbook* is on how people learn from words and pictures in computer-based environments. The book is organized into five parts

that cover theoretical foundations, basic foundations, advanced principles of multimedia learning, multimedia learning in specific content areas, such as history, mathematics, and second language acquisition, and multimedia learning in advanced computer-based contexts, including games, hypermedia, and e-courses. The major theoretical foundation of the multimedia learning theory is the proposition that in order to be effective, design needs to reflect the human cognitive structure. Multimedia learning is a demanding process in which the learner selects relevant words and images, organizes them into coherent verbal and pictorial representations, and integrates verbal and pictorial representations. Multimedia messages that are designed with knowledge of how the multimedia process works are more likely to lead to meaningful learning. The *Handbook* reviews basic multimedia principles that are supported by empirically derived theories, including the following:

- *Multimedia principle*: People learn more or more deeply when appropriate pictures are added to the text.
- *Split-attention principle*: When designing instruction, it is important to avoid formats that require learners to split their attention between multiple sources of information.
- *Modality principle*: People learn better from graphics and narration than graphics and printed text.
- *Redundancy principle*: People learn better when the same information is not presented in more than one format.

The book also explores the research evidence for advanced principles of multimedia learning:

- *Guided-discovery principle*: People learn better when guidance is incorporated into discovery-based multimedia environments.
- *Worked-out example principle*: People learn better when they receive worked-out examples in initial skill learning.
- *Collaboration principle*: People can learn better with collaborative online learning activities.

- *Self-explanation principle*: People learn better when they are encouraged to generate self-explanations during learning.
- *Animation and interactivity principles*: People do not necessarily learn better from animation than from static diagrams.
- *Navigation principles*: People learn better in hypertext environments when appropriate navigation aids are provided.
- *Site map principle*: People can learn better in an online environment when the interface includes a map showing where the learner is in the lesson.
- *Prior knowledge principle*: Instructional design principles that enhance multimedia learning for novices may hinder multimedia learning for more expert learners.
- *Cognitive aging principle*: Instructional design principles that effectively expand working memory capacity are especially helpful for older learners.

Despite the extensive research conducted on multimedia learning, publishers have been slow in adopting it to create their textbooks. As Kamil notes,

There appears to be little communication between the various stakeholders in efforts surrounding research, production, and use of textbooks. [...] A great deal of relevant research exists, but there is no infrastructure to deliver it. [...] More typical is to focus on making students better readers without regard for the quality of the texts they have to read (2).

Second, even though publishers are introducing innovative initiatives such as the Wiley Visualizing series, they often still think in the traditional way and change is not always easy to accept. Creating the visual list using the Visualizing method means radically changing the editorial process and retraining most of the staff. In addition, in challenging economic times like the current one, publishers tend to have fewer resources, financial and human, to experiment and innovate. Editors are expected to take care of an increasingly wider variety of aspects of book production, such as supplements for the online course accompanying the

physical book, and they cannot always find time to follow every aspect of the artwork program.

In spite of these challenges, the Wiley Visualizing series is an excellent practical example of how visuals can successfully become content drivers. The Visualizing project is quite new, yet the positive response from instructors and students indicates that these textbooks are effective and that conceiving a textbook with both text and visuals in mind is feasible and worthwhile. Ideally, the Wiley Visualizing series will be a starting point for Wiley and other publishers to use the Visualizing method not only for one series, but for all textbooks.

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