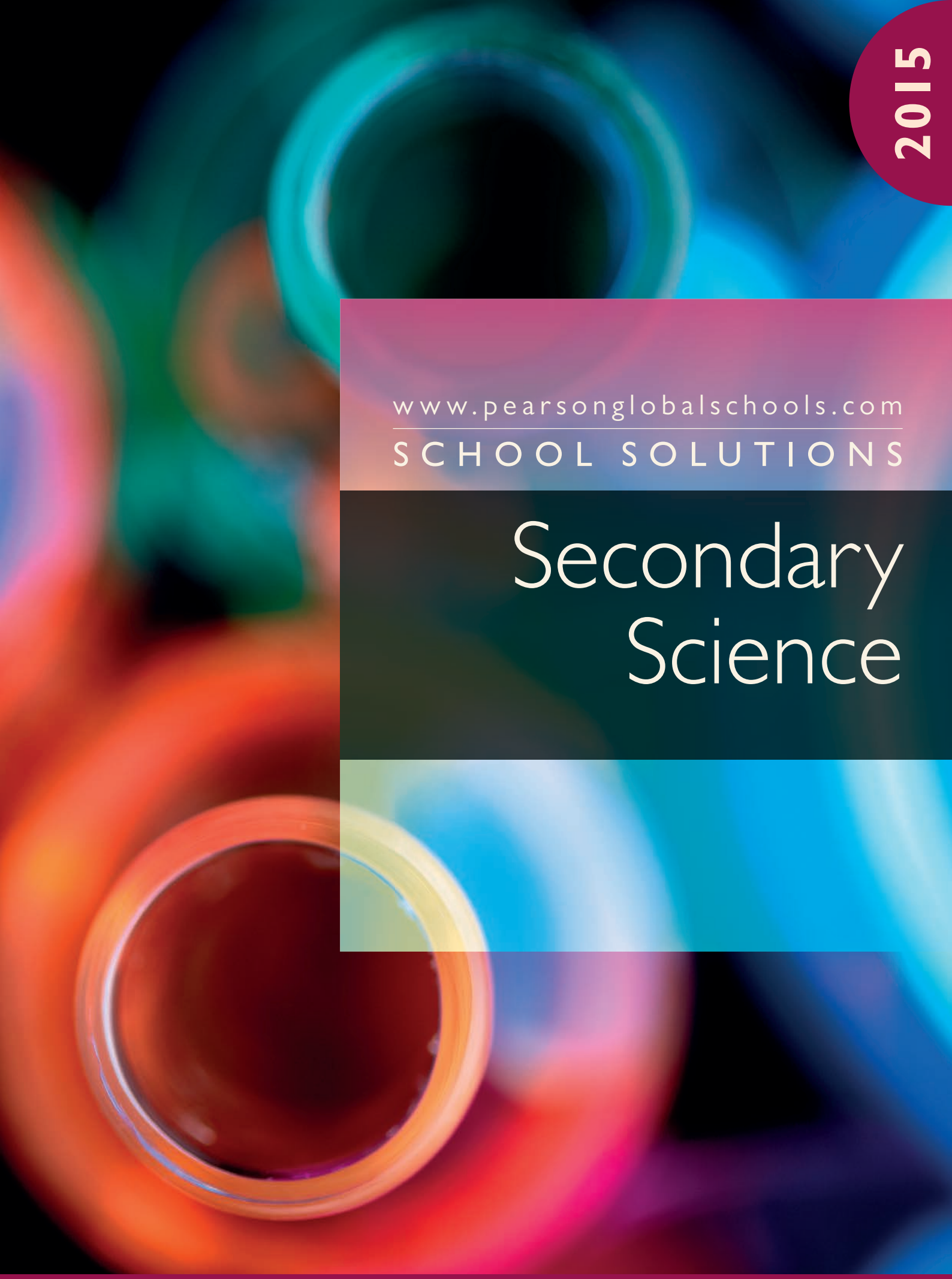

2015

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SCHOOL SOLUTIONS

Secondary Science

ALWAYS LEARNING

PEARSON

Improving teaching and learning for all

Pearson helps people make progress in their lives through learning. Our vision is to help young children and school students all around the world to reach their learning potential and to prepare them for future success in further education or in the workplace.

By combining content, assessment, teacher training and technology, we support teachers and students on their unique path to success by ensuring learning is personalised. This catalogue focuses on our teaching and learning resources which are all designed to get the best out of each and every student.

Find your perfect solution

Find the resource for your curriculum needs.

- ELL Suitable for English Language Learners
- IB Written specifically for the International Baccalaureate
- INTERNATIONAL GCSE Written specifically for the International GCSE
- Includes a component with audio
- CC For the Common Core State Standards
- Published in the UK
- Published in the USA
- Published in Singapore
- This program is also available in Spanish

Browse the catalogue by age, years or grades:

Age	IB	United States	United Kingdom		Australia
11–12	MYP	Grade 6	Year 7	Key Stage 3	Grade 6
12–13		Grade 7	Year 8		Grade 7
13–14		Grade 8	Year 9		Grade 8
14–15		Grade 9	Year 10	Key Stage 4 / GCSE / International GCSE	Grade 9
15–16		Grade 10	Year 11		Grade 10
16–17	Diploma	Grade 11	Year 12	Key Stage 5 AS / A Level	Grade 11
17–18		Grade 12	Year 13		Grade 12

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Exploring Science: Working Scientifically 11-14

Measurable progression in Key Stage 3 Science for every student in every lesson – from the UK's number one science course!

FOR THE NEW 2014 UK CURRICULUM!

See pages 24-28

Edexcel A level 2015 Science 16-19

Developing scientists for A level and beyond

See page 64

OCR A level 2015 Science 16-19

From the team that brought you the tried and trusted OCR A level Science in 2008

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NEW COMPONENTS FOR 2015

NEW eTexts for the Pearson Baccalaureate IB Diploma

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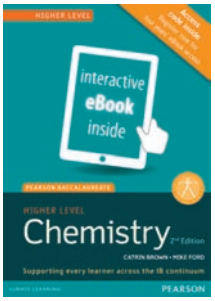

NEW ActiveLearn for A Level Science

See pages 61-67

Supporting you through curriculum and standards changes

With ever-changing curricula and standards, we realise there is uncertainty and upheaval. The demands are increasingly challenging and children and teachers are being pushed further and faster than ever.

Our goal is to provide you with support to ensure your school is prepared for change and to provide the easiest possible transition to teaching the new curriculum or standards with confidence.

Common Core State Standards

If you have decided to implement the Common Core State Standards (CCSS) in your school, we can help you by providing CCSS aligned resources, assessment solutions and professional development to help make implementation easier. Look out for the CC symbol in this catalogue and speak to your local representative to learn more.

commoncore.pearsoned.com

Next Generation Science Standards

The Next Generation Science Standards* (NGSS) were drafted to provide a strong science education that improves student achievement through critical thinking, personalised learning, and practice. To implement the NGSS in your school, you'll need trusted instructional resources that are correlated to the new standards. Find out more about our aligned resources from your local representative.

pearsonschool.com/ngss

UK Secondary Curriculum

There are changes happening at Key Stage 3 (statutory in England from Sept 2014), along with reforms in GCSE and A Levels in 2015 and 2016. As teachers you need the support and materials to help you plan and implement the new specifications successfully and your learners will need help transitioning to each next stage. Our new resources have been designed to do just that.

21st Century learning starts with the transition to digital

21st Century learners need engaging and personalised learning experiences that lay the groundwork for higher education and career readiness. Today's teachers need flexible learning environments that enable them to teach in a variety of ways with easy-to-use systems to monitor achievement and personalise instruction.

The transition to digital can be overwhelming and we understand that each school is on a different path. Your local Pearson Consultant can talk you through our digital solutions best suited to meet your unique needs.

Digital resources for personalised learning

Pearson delivers digital curricula resources to personalise, deliver and track progress so every student can learn at his or her own pace in the classroom and at home.

Look out for the green digital boxes in this catalogue which explain the technology and technical requirements within each programme.

Online Digital Path

Online Digital Paths are the platforms that deliver the teaching and learning content and tools. There are a handful of different platforms across our global portfolio. The following two pages give more information on these.

eBooks and eTexts

For US eBooks download Pearson eText App. UK eBooks are within the ActiveLearn online digital paths.

App

Perfect for today's digital natives our pupil Apps enhance instruction. We also have teacher Apps which allow the teacher to differentiate instruction and track progress in real time.

IWB

Boost whole-class involvement with these interactive resources.

CD/DVD

Schools without reliable internet access can enjoy the interactive aspects of some of our digital resources with CD/DVD products.

Online Digital Paths for personalised learning

Our digital teaching and learning resources are delivered across a handful of platforms. Read on to learn more about how they can help you to easily and effectively personalise learning for all students. Then look out for these in the digital boxes on each product page, to understand which platform powers each product.

ActiveLearn is a motivating and supportive online independent learning resource for the classroom and at home - for Key Stage 3, GCSE and A level students. It supports the learner with an ActiveCourse providing student activities and exercises, and an enhanced interactive ActiveBook version of the associated course text book. Ipad compatible.

Realize gives you the power to raise the interest and achievement of every student. It offers rich and engaging content, embedded assessment with instant data, and flexible tools to manage your classroom. For teachers following a US curriculum, it provides a source of premium content correlated to the Common Core Standards. Realize will soon host most of our K12 US resources, starting with *digits*. ipad compatible.

These platforms organise the US K12 products in one place. Teachers can do all their planning and tracking in the same location to save time. It extends learning beyond the textbook by providing rich and digital content for digital natives. It allows transparency of student progress to enable the teacher to effectively offer personalised instruction for all.

Supporting English Language Learners

English Language Learners (ELLs) are the fastest growing student population. ELLs have twice the challenge. They're learning a new language while simultaneously learning academic content. They come from a wide variety of home language groups and their English proficiency levels differ. They all need support to reach their full potential.

We offer instructional resources from around the globe that focus on the development of language proficiency and academic knowledge. The ELL symbol throughout the catalogue recognises these resources, Interactive Science (page 16) and Language Central for Science (page 32).

The Pearson English Learning System has been created for schools following a US curriculum. It provides an integrated solution specifically for K-12 ELLs including:

- Assessment tools that benchmark, monitor, and track student progress.
- Professional Development, rooted in research and empirically validated, including SIOP® and A+RISE®
- Instructional materials that focus on the development of language proficiency and academic knowledge.

Speak to your local Pearson contact to learn more about the Pearson English Language Learning System.

Customized, Research-Based Courses

Courses for educators of all disciplines help them apply effective principles to improve the performance of their students. Research-based courses are embedded in real teaching practices developed to improve student performance.

Certified Trainers

Courses are delivered by credentialed trainers who have completed Pearson's Certified Teacher Trainer Course.

Efficacy

Regular and structured measurement of our products and services is designed to ensure they deliver on their intended outcomes.

Diagnostic Evaluation

Diagnostic tests and teaching evaluations measure and improve instructional effectiveness.

The Teacher Education & Leadership Academy is a Pearson training institute, which offers online, face-to-face, or blended professional development services to increase teacher effectiveness and ultimately student success. Our focus is to equip teachers and school leaders with high quality, research-based learning programs and resources for the 21st century classroom.

Accreditation and Qualifications

Internationally recognized certification for teachers and school leaders is issued by Edexcel, the UKs largest Awarding Organisation.

Teacher Education & Leadership Academy

Professional Development for Global Educators

Virtual Resource Center

We support development needs with access to our comprehensive library of resources and social networking hub through our website.

for a full list of courses please refer to our website
www.pearsonteacheracademy.com

FRONTER
The world's favourite classroom

Fronter is the leading learning platform for schools, delivered as a service over the internet. With about 160 million logins per year, Fronter is transforming schools – the way technology has transformed the society our children are growing up in.

Global Community

What is the difference between a teacher in Helsinki, Abu Dhabi or São Paulo? Not much in our experience. Innovation in education is driven by teachers. Because the teacher is the key to pupils' success, Fronter was built to help teachers be great teachers.

Secure Environment

Fronter is a safe learning environment accessed via a web browser. You control the access rights. We host all your data in a private cloud where you have full ownership and control. We think that is important.

A World of Learning

Fronter is a collection of core tools for teaching and learning. But we believe in openness, which is why we have made it incredibly easy to use other apps and rich content from within Fronter. Every night we exchange data with hundreds of different systems securely, so that you can login in one place and find everything you need.

Leading the Way

Fronter is a pioneer product. The world has changed since it launched in 1998, but Fronter's commitment to helping teachers be great teachers has not. Fronter continues to evolve with the enthusiastic involvement of teachers all over the world. With Fronter you have thousands of colleagues supporting you in a modern approach to learning.

EQUELLA
Digital repository

EQUELLA provides one platform to house your teaching and learning, research, media and library content.

Content Tagging

EQUELLA raises the visibility and usage of high quality and relevant content, providing teachers and students with the most effective and engaging content.

Copyright and Digital Rights Management

Via attribution of ownership across courses and delivery platforms, users can ensure their content is protected and complies with copyright regulations.

Efficient Reporting of Content Usage

With a consistent structure and analytics in place to measure usage and effectiveness of learning content, educators can make better decisions about what materials to use in their courses.

Extended LMS Integrations

EQUELLA integrates with third party systems, including popular Learning Management Systems; Fronter, Pearson LearningStudio, Moodle, Blackboard and Sakai.

Enhance your content with EQUELLA. Visit equella.com

PowerSchool
Student information system

The SIS

PowerSchool takes care of all your school administration and makes managing pupil data easy. Enjoy a full range of features including: attendance management, tracking and notification, assessment records, custom report cards, discipline management and reporting, centralised enrollment, timetables, emergency and medical information, school fee management all of which can be accessed via iPhone or Android compatible phones.

A SIS that involves teachers, pupils and parents

Powerschool is more than a tool for school administrators to do the 'office work'. Powerschool includes PowerTeacher, Pearson's web based classroom management solution with a range of functions that allows a teacher to stay better organised, freeing up time for teaching. Pupils take ownership of their learning by logging in to see grades and teacher comments. Parents can follow more closely their child's education online anywhere and anytime, with access to real-time grades and attendance, teacher feedback and more.

A SIS for school IT staff

Powerschool simplifies SIS administration with a secure, web-based architecture built on a robust JAVA framework and a powerful Oracle database. If you need it to be, it can be locally installed for self hosters and has a full complement of disaster-proof, redundancy-laden, security measures to help you sleep at night.

Visit powerschool.com to learn more

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Stay connected with the latest news from Pearson Global Schools by signing up to our eNewsletters and eAlerts. Be one of the first to receive information on our newest products, exclusive special offers and industry insights from our experts.

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Evaluate the Pearson Global Schools resources online

Many of our Global Schools resources are now available to sample online. As well as being environmentally friendly, this also means you can evaluate our resources at your own pace, anytime and anywhere.

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PEARSON OLE online learning exchange™

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Sign up for a FREE 30-day trial at http://olecommunity.com/global-trial/ today!

- ✓ Online Digital Path
- ✓ eBooks* (Online, PC/Mac/Tablet)

*Download *Pearson eText for Schools* App to access eBook.

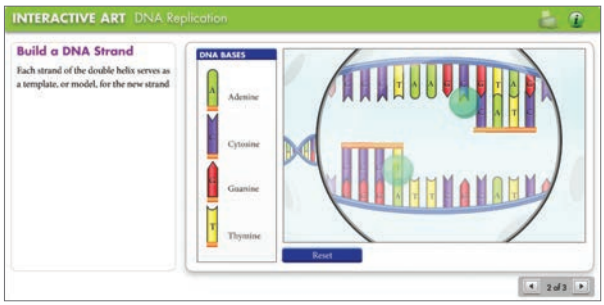
Online Learning Exchange ©2013

Search smarter. Love what you find.

Middle grades science

With *OLE Science* for grades 6–8, you'll have thousands of videos, animations, interactive activities and assessments to supplement your middle grades science curriculum - whether it is spiraled, integrated, or divided into discrete life, earth, and physical science courses.

- Save time searching for quality teaching resources.
- Build your own customized lessons and tests.
- Upload your own materials and links to open educational resources.
- Collaborate with students and teachers.
- Access OLE from any mobile device.



MIDDLE GRADES SCIENCE 6-8 OLE COURSE SUBSCRIPTION PRICING

OLE Science Courses Per Student Pricing

OLE 1-YEAR COURSE ACCESS	
Life Science, Grades 6-8	978 0 133188 55 4
Earth Science, Grades 6-8	978 0 133188 56 1
Physical Science, Grades 6-8	978 0 133188 57 8

OLE 3-YEAR COURSE ACCESS	
Life Science, Grades 6-8	978 0 133272 87 1
Earth Science, Grades 6-8	978 0 133272 88 8
Physical Science, Grades 6-8	978 0 133272 90 1

OLE 6-YEAR COURSE ACCESS	
Life Science, Grades 6-8	978 0 133238 48 8
Earth Science, Grades 6-8	978 0 133238 50 1
Physical Science, Grades 6-8	978 0 133238 52 5

MIDDLE GRADES SCIENCE 6-8 OLE COURSE + ETEXT BUNDLE SUBSCRIPTION PRICING

OLE Science Courses + eText Per Student Pricing

OLE BUNDLE OPTION FOR 1-YEAR COURSE + 1 YEAR ETEXT ACCESS	
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Life Science, Grades 6-8 (Modular Version - 4 eTexts)	978 0 133236 55 2
Earth Science, Grades 6-8 (LEP Version)	978 0 133236 56 9
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Physical Science, Grades 6-8 (LEP Version)	978 0 133236 58 3
Physical Science, Grades 6-8 (Modular Version - 4 eTexts)	978 0 133236 59 0
LEP Integrated Course, Grades 6-8 (Integrated Version - 4 eTexts)	978 0 133264 85 2

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Earth Science, Grades 6-8 (LEP Version)	978 0 133272 95 6
Earth Science, Grades 6-8 (Modular Version - 4 eTexts)	978 0 133272 99 4
Physical Science, Grades 6-8 (LEP Version)	978 0 133272 96 3
Physical Science, Grades 6-8 (Modular Version - 4 eTexts)	978 0 133273 00 7
LEP Integrated Course, Grades 6-8 (Integrated Version - 4 eTexts)	978 0 133273 01 4

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Physical Science, Grades 6-8 (LEP Version)	978 0 133236 63 7
Physical Science, Grades 6-8 (Modular Version - 4 eTexts)	978 0 133236 64 4
LEP Integrated Course, Grades 6-8 (Integrated Version - 4 eTexts)	978 0 133264 86 9

See page 51 for details of components for High School materials.

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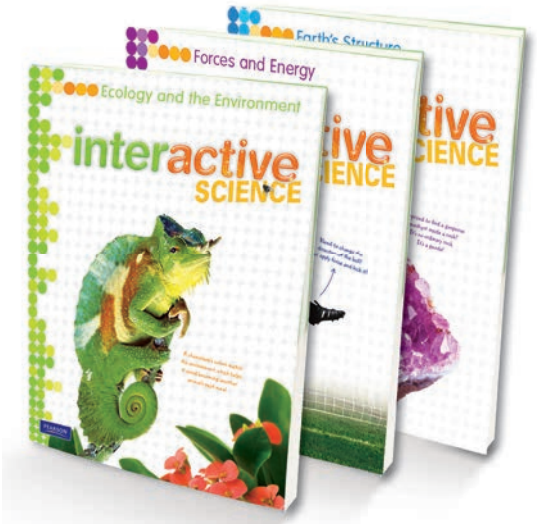
Interact with your world

ELL

A next-generation, middle grades science program that makes learning personal, engaging and relevant for today's students. **Interactive Science** features an innovative write-in *Student Edition* that enables students to become active participants in their learning and truly connect the Big Ideas of science to their world.

Hold the attention of your media-savvy learners with digital and online teaching options that blend seamlessly with the write-in *Student Edition* to create a unique experience for all learning and teaching styles.



Fully flexible offering 3 pathways to engage students!

Success Tracker™

Easily track student progress with Success Tracker™, a state-of-the-art, online formative assessment and remediation management system.

Resources for K-5 also available - see website for further details.

This program is also available in Spanish

We also offer practical, effective professional development designed to help you implement this program with fidelity. Learn more online.

Empowers students through personalized learning

- The write-in *Student Edition* personalizes science instruction through active learning, allowing students to read, write, draw, graph, and self-assess all in one place.
- Students can conveniently access the full content of their write-in *Student Edition* online or on CD-ROM.
- The multilingual glossary of scientific vocabulary words includes translations from 13 different languages for each word.

Provides more inquiry in more places

- A variety of hands-on and minds-on inquiry options keep all your students engaged.
- A *Teacher's Lab Resource* and a wide variety of blackline masters provide opportunities for hands-on inquiry every day.

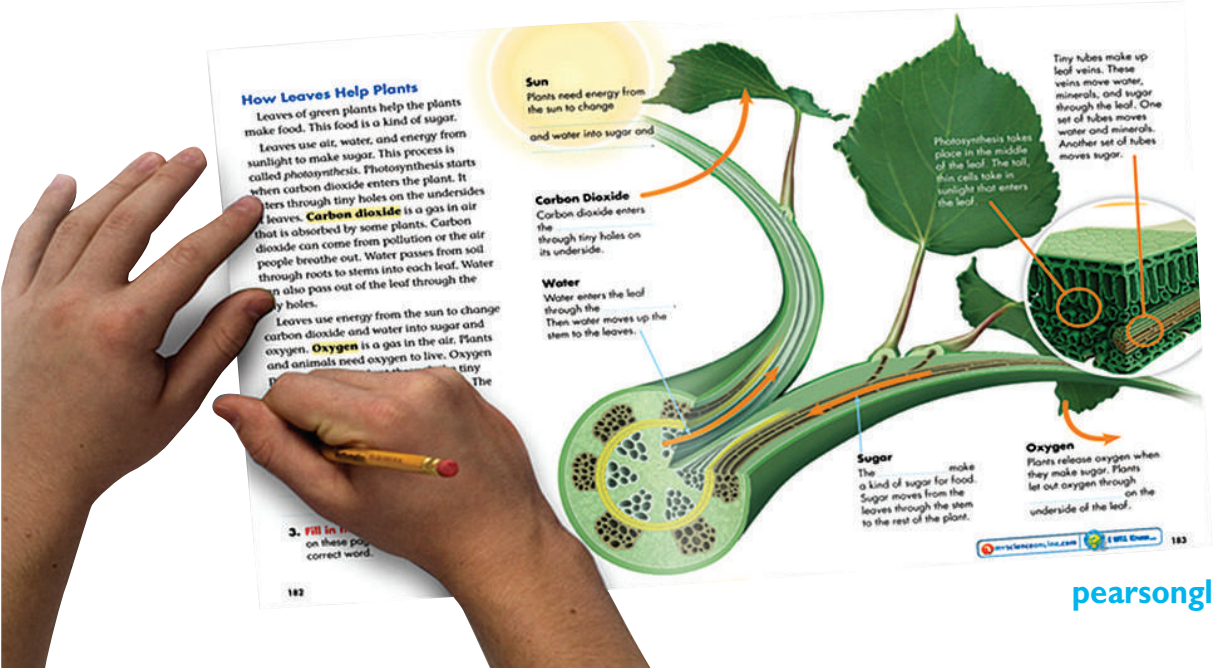
Everything you need to plan, teach, assess, and meet the needs of all learners

The *Teacher's Edition and* online Teaching Resources provides everything you need to successfully teach **Interactive Science**, and includes:

- Powerful teaching strategies for every lesson, with expert author commentary
- Three types of lesson plan options: digital focus, inquiry focus, and a blended approach
- Wrap-around notes with enhanced strategies for English Language Learners and differentiated instructional support for students of differing abilities
- An essential *Program Guide* gives you a comprehensive overview of the **Interactive Science** program, including a summary of standards and advice on using the various tools, so you can successfully implement the program in your classroom
- Create and print tests or study guides in minutes from a bank of thousands of questions, with *ExamView® Assessment Suite CD-ROM*. View individual or whole-class reports of test results.

For teachers, **MyScienceOnline.com** provides:

- Preferences Navigator – to customize teaching style and personalize curriculum
- Online Classroom Management – access the *Teacher's Edition*, set up a class, assign homework, get reports and more!



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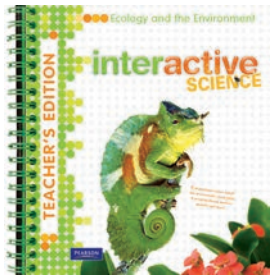
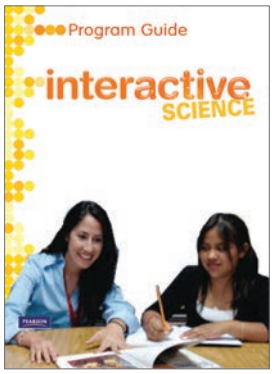
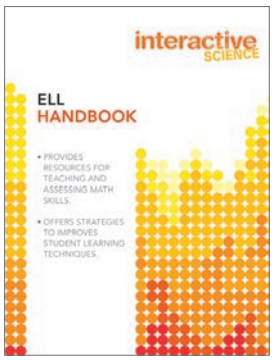






- Online Digital Path (SuccessNet, see page 9)
- eBooks* (Online, PC/Mac/Tablet/CD)
- IWB
- CD (Audio)

*Download *Pearson eText for Schools* App to access eBook.

Engages students with personalized technology

The next generation of online science learning is here! At **MyScienceOnline.com** you'll find a wealth of resources that you and your students can use to personalize your online learning experience, including:

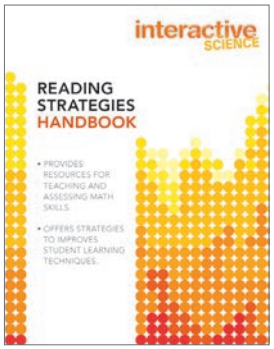
- *Interactive Art* – makes textbooks spring to life online
- *Untamed Science Videos* – exciting online video blogs make science cool!
- *Virtual Labs* – bring science concepts to life with realistic virtual labs
- *My Planet Diary* – takes students on a journey to amazing parts of our planet, with biographies from researchers, facts from around the world and testimonials from young scientists
- *My Reading Web* – gives extra help on a particular science topic at students' specific reading level
- Additional Support providing extra practice on key science concepts.

My Planet Diary from **Interactive Science** Grades 6-8 Earth's Structure MyScienceOnline.com

Interactive Student eText!

Now available for iPad® and other tablet devices!

On the go where you go, Pearson eTexts are available for a variety of devices.



Supports students' reading and math skills

Help students be better prepared for tests by practising the written and math skills needed in science:

- The *Reading Strategies Handbook* presents section summaries, vocabulary reviews, and study worksheets;
- The *Math Skill and Problem-Solving Handbook* provides math content support and a variety of practice opportunities so students can master math skills and problem solving in science.

Interactive Science ©2011

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Earths Surface: Teachers Edition and Resource	978 0 133693 61 4
Earths Surface: Teachers Lab Resource	978 0 133705 47 8
Water and The Atmosphere: Teachers Edition and Resource	978 0 133693 62 1
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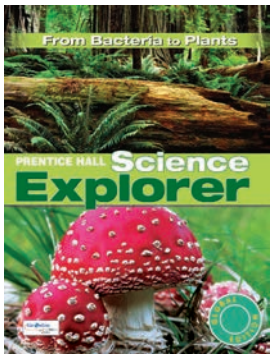
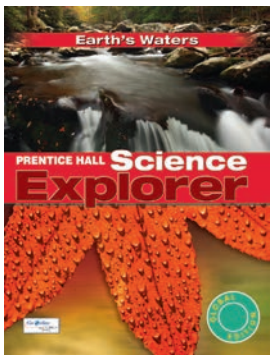
See pages 34-35





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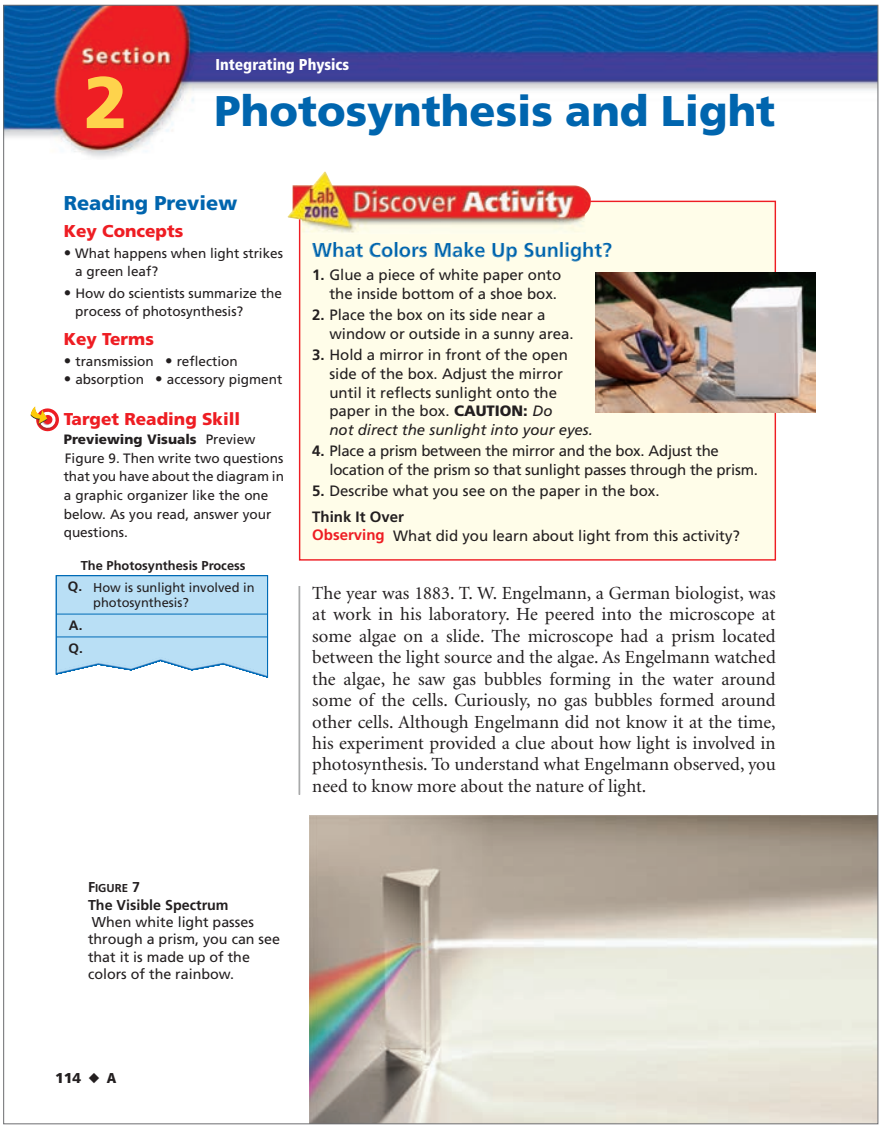

Section 2 Integrating Physics

Photosynthesis and Light

Reading Preview

Key Concepts
- What happens when light strikes a green leaf?
- How do scientists summarize the process of photosynthesis?

Key Terms
- transmission • reflection
- absorption • accessory pigment

Target Reading Skill
Previewing Visuals Preview Figure 9. Then write two questions that you have about the diagram in a graphic organizer like the one below. As you read, answer your questions.

The Photosynthesis Process

Q. How is sunlight involved in photosynthesis?
A.
Q.

Lab zone Discover Activity

What Colors Make Up Sunlight?

1. Glue a piece of white paper onto the inside bottom of a shoe box.
2. Place the box on its side near a window or outside in a sunny area.
3. Hold a mirror in front of the open side of the box. Adjust the mirror until it reflects sunlight onto the paper in the box. **CAUTION:** *Do not direct the sunlight into your eyes.*
4. Place a prism between the mirror and the box. Adjust the location of the prism so that sunlight passes through the prism.
5. Describe what you see on the paper in the box.

Think It Over
Observing What did you learn about light from this activity?

The year was 1883. T. W. Engelmann, a German biologist, was at work in his laboratory. He peered into the microscope at some algae on a slide. The microscope had a prism located between the light source and the algae. As Engelmann watched the algae, he saw gas bubbles forming in the water around some of the cells. Curiously, no gas bubbles formed around other cells. Although Engelmann did not know it at the time, his experiment provided a clue about how light is involved in photosynthesis. To understand what Engelmann observed, you need to know more about the nature of light.

FIGURE 7
The Visible Spectrum
When white light passes through a prism, you can see that it is made up of the colors of the rainbow.

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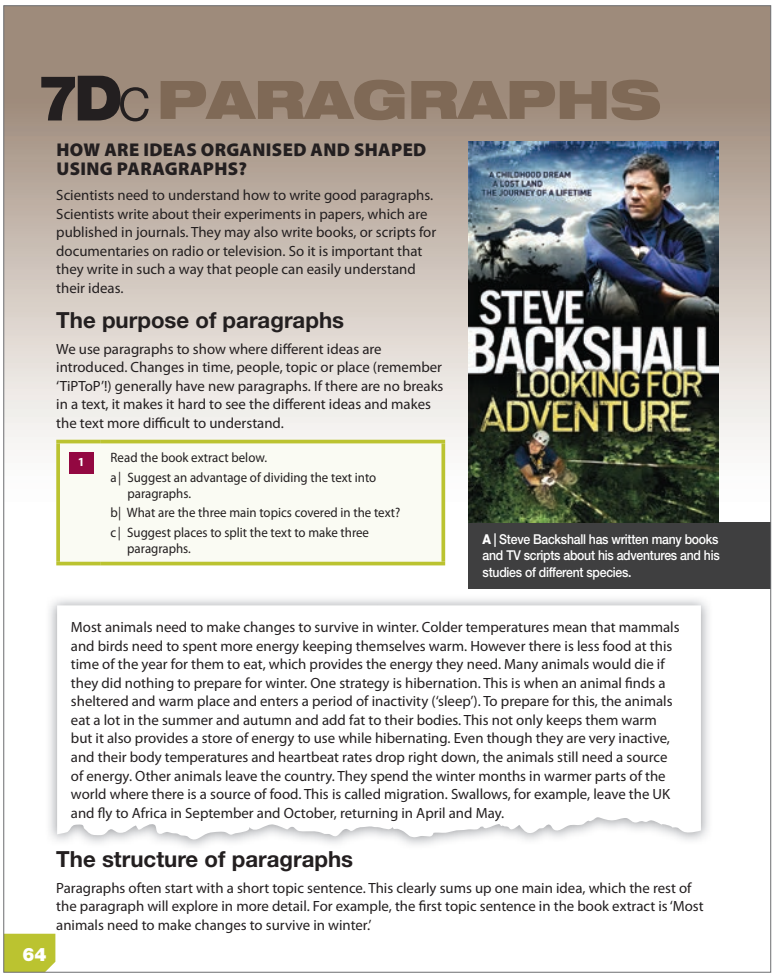

7Dc PARAGRAPHS

HOW ARE IDEAS ORGANISED AND SHAPED USING PARAGRAPHS?

Scientists need to understand how to write good paragraphs. Scientists write about their experiments in papers, which are published in journals. They may also write books, or scripts for documentaries on radio or television. So it is important that they write in such a way that people can easily understand their ideas.

The purpose of paragraphs

We use paragraphs to show where different ideas are introduced. Changes in time, people, topic or place (remember 'TiPToP'!) generally have new paragraphs. If there are no breaks in a text, it makes it hard to see the different ideas and makes the text more difficult to understand.

1 Read the book extract below.
a| Suggest an advantage of dividing the text into paragraphs.
b| What are the three main topics covered in the text?
c| Suggest places to split the text to make three paragraphs.

A | Steve Backshall has written many books and TV scripts about his adventures and his studies of different species.

Most animals need to make changes to survive in winter. Colder temperatures mean that mammals and birds need to spent more energy keeping themselves warm. However there is less food at this time of the year for them to eat, which provides the energy they need. Many animals would die if they did nothing to prepare for winter. One strategy is hibernation. This is when an animal finds a sheltered and warm place and enters a period of inactivity ('sleep'). To prepare for this, the animals eat a lot in the summer and autumn and add fat to their bodies. This not only keeps them warm but it also provides a store of energy to use while hibernating. Even though they are very inactive, and their body temperatures and heartbeat rates drop right down, the animals still need a source of energy. Other animals leave the country. They spend the winter months in warmer parts of the world where there is a source of food. This is called migration. Swallows, for example, leave the UK and fly to Africa in September and October, returning in April and May.

The structure of paragraphs

Paragraphs often start with a short topic sentence. This clearly sums up one main idea, which the rest of the paragraph will explore in more detail. For example, the first topic sentence in the book extract is 'Most animals need to make changes to survive in winter.'

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7Cc THE SKELETON

WHAT ARE THE FUNCTIONS OF THE SKELETON?

People who do sport for a living need to get treatment quickly if they are injured. Big football clubs spend millions on building specialist treatment centres to ensure their players get the best possible treatment.

Bones

Many people think that bones are not living, but bones *are* living organs. They grow as you grow and repair themselves if they **fracture** (break). Bones are hard and strong so that they can stand up to hard knocks and **pressure**. They are also light so they can be moved easily.

A | Common footballing injuries include broken bones and damage to cartilage, tendons and ligaments.

circles of bone produced by bone-making cells called osteoblasts

cartilage tissue

Spongy bone material has many spaces in it to keep the whole bone light.

Compact bone material is very hard and strong, but is also heavy. It is used to form a tube shape, which is a very strong shape.

The inside of a bone is filled with bone marrow tissue. This helps to reduce the mass of the bone (and the bone marrow makes blood cells).

B | Bone-making cells (osteoblasts) can produce bone material in different ways, forming compact bone and spongy bone.

FACT

Babies are born with about 270 bones but some of them fuse together as they grow. An adult has 206 bones.

1 a| State two things that osteoblasts need to stay alive.
b| What process do osteoblasts need these things for?
2 Explain why a large bone can be both strong and light.
3 How can you tell that the bone in diagram B is an organ?

Support

The bones in your body form your **skeleton**, shown in photo C. Your skeleton makes sure that your body keeps its shape and also supports your body. The **backbone** is made up of smaller bones called **vertebrae** and is the human body's main support.

Some bones help to support organs. For example, your lungs would collapse without your ribs.

4 What do your ribs and sternum form?
5 Give one function of the backbone.

skull
collar bone
upper arm bone
sternum
ribcage
ribs
vertebrae (small bones in the back make up the 'backbone')
forearm bones
hip
thigh bone
knee cap
shin bone

C | a skeleton

Movement

Two bones next to each other can form a **flexible joint**. The bones in a flexible joint are moved by muscles, which are attached to the bones by **tendons**. **Ligaments** hold the bones in a flexible joint together. The ends of bones in a flexible joint are often covered in a slippery tissue called **cartilage**, which helps them slide past each other.

Flexible joints can be damaged when playing sports. A sprain occurs when a ligament is stretched or torn. Sprains can cause dislocations, in which bones in a joint move out of line so that the joint doesn't work. When people 'pull muscles', either a muscle or the tendon that connects the muscle to a bone gets a small tear in it.

upper arm bone
muscles
tendon
ligament
forearm bones
tendon
cartilage

F | An elbow is a type of flexible joint called a 'hinge joint'.

Protection

Some bones protect organs in the body. For example, the **skull** protects the **brain**. The skull is actually made of 22 bones that are joined by **fixed joints**.

fixed joints don't move

D

6 The nervous system includes the brain and the spinal cord. Your spinal cord is a large bundle of important nerves that runs down your back. Which bones protect:
a| your brain b| your spinal cord?
7 Which organs are protected by your ribcage?

FACT

The smallest bone in the body is the stapes or stirrup bone in the ear. It's about the size of a grain of rice, and its function is to transfer sound waves into the inner ear.

E | X-rays allow us to see bones inside the body. This is an X-ray of a hip, which is a type of flexible joint called a 'ball and socket' joint.

8 a| List three different types of joint.
b| Which of these joints allows movement in the most directions?
c| What causes the bones to move?
9 Describe the different functions of bones.
10 Look at X-ray E.
a| What bone forms the 'ball' in this joint?
b| The joint on the right of the X-ray is normal. What has happened to the joint on the left?
c| Suggest how this has occurred.

I can ...
- describe the functions of different bones in the skeleton
- describe some different types of joint.

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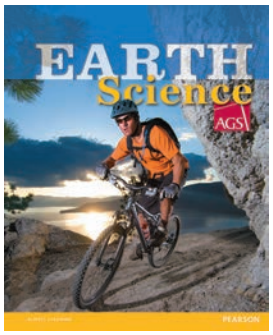

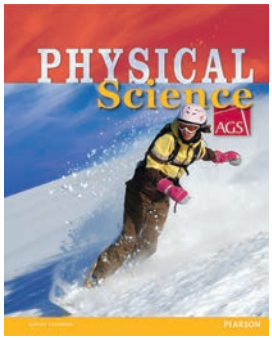

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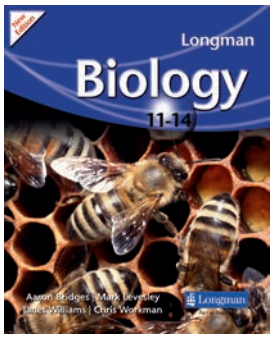

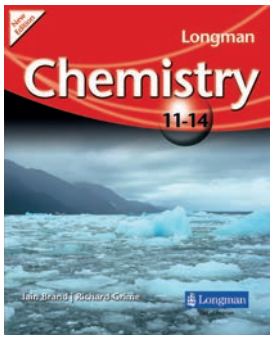

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Longman 11-14 Biology, Chemistry & Physics

Motivate, challenge and stretch able pupils

ELL

Designed specifically to motivate high attainers, these latest editions of **Longman 11-14** provide an academic, rigorous and in-depth approach to science.

Pupil Books

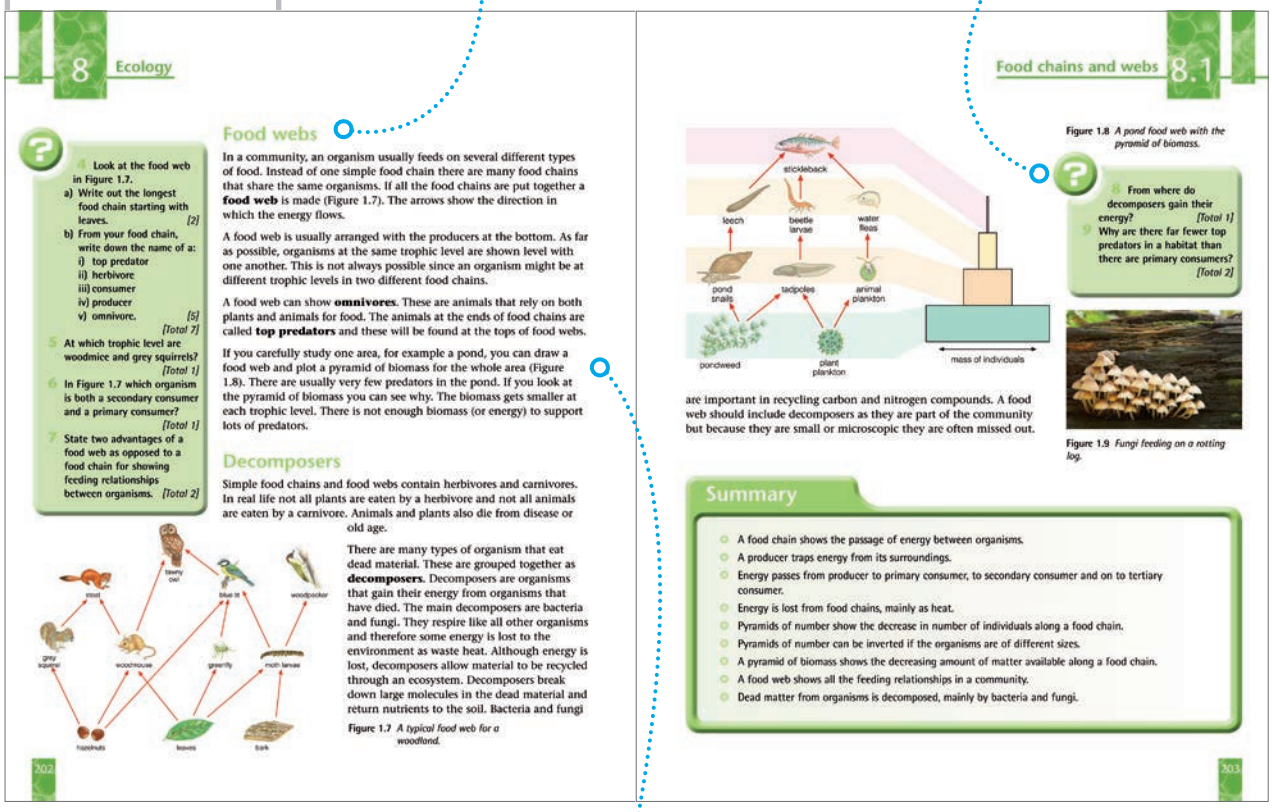
Fully updated to give 11-14 year olds the best preparation for GCSE, the Edexcel International GCSE or the Cambridge IGCSE, as well as satisfying the UK Key Stage 3 Programme of Study, these *Pupil Books*:

- Engage and challenge your more able pupils with an academic, rigorous and in-depth approach.
- Reflect the knowledge and skills pupils will need to demonstrate at GCSE and IGCSE/ International GCSE to facilitate seamless progression.
- Allow you to embed as much or as little How Science Works as you need.

Content organised into chapters not spreads, so pupils are not limited by the format.

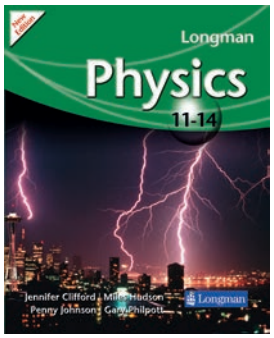
Ramped questions reinforce, consolidate and extend learning.

Pupil Worksheet



Sample pages from **Longman Biology 11-14: Pupil Book**

In-depth approach to the content motivates and challenges more able pupils.

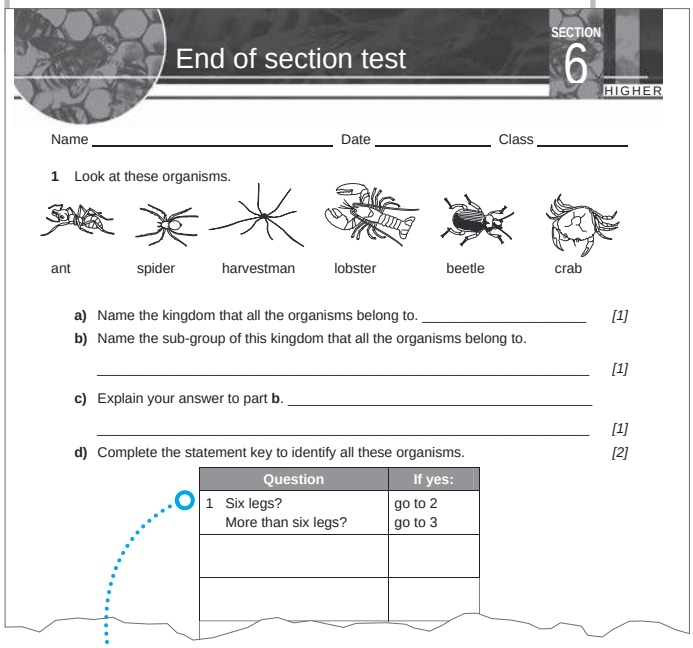


Practical and Assessment Teacher Packs

Full of time-saving resources for you and your technicians, these new *Practical and Assessment Teacher Packs* include classwork and homework activities, teacher plans, and an array of assessment materials to help you effectively track your pupils' progress.

- End-of-chapter tests at two ability tiers, progression ladders and quick-fire questions allow for self-assessment.
- Flexible long-term plans help you to deliver the course over two or three years.
- Extension materials cater for the very able.

Practical and Assessment Teacher Packs



End of section test

SECTION 6 HIGHER

Name _____ Date _____ Class _____

1 Look at these organisms.

ant spider harvestman lobster beetle crab

a) Name the kingdom that all the organisms belong to. _____ *[1]*

b) Name the sub-group of this kingdom that all the organisms belong to.

_____ *[1]*

c) Explain your answer to part **b**. _____

_____ *[1]*

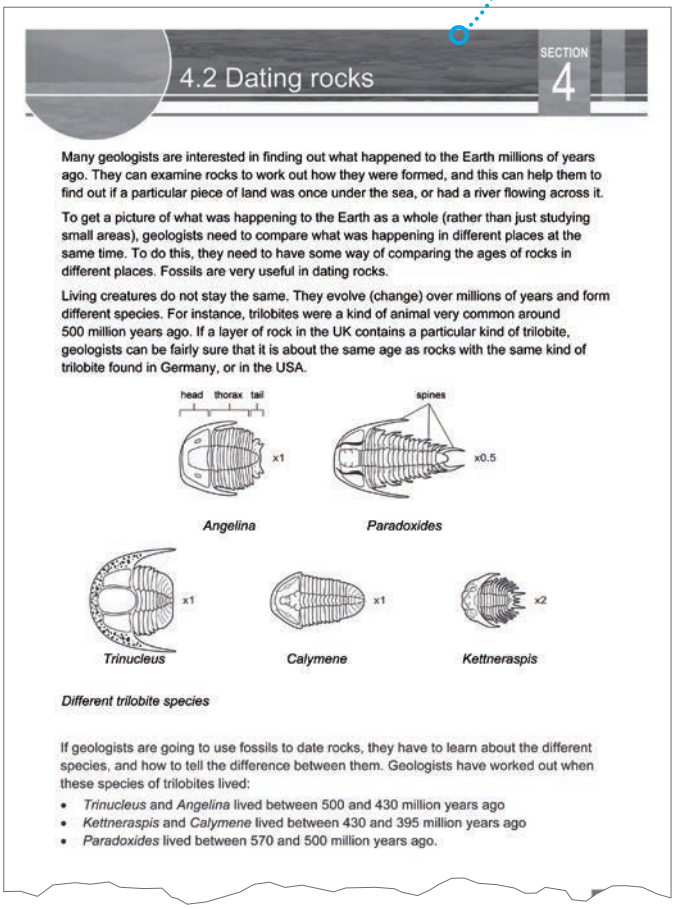
d) Complete the statement key to identify all these organisms. *[2]*

Question	If yes:
1 Six legs? More than six legs?	go to 2 go to 3

Sample pages from **Longman Biology 11-14: Practical and Assessment Teacher Pack**

End of section tests at two ability tiers help you easily assess your pupils.

Topic worksheets with lots of questions encourage pupils to explore the subject further and consolidate learning.



4.2 Dating rocks

SECTION 4

Many geologists are interested in finding out what happened to the Earth millions of years ago. They can examine rocks to work out how they were formed, and this can help them to find out if a particular piece of land was once under the sea, or had a river flowing across it.

To get a picture of what was happening to the Earth as a whole (rather than just studying small areas), geologists need to compare what was happening in different places at the same time. To do this, they need to have some way of comparing the ages of rocks in different places. Fossils are very useful in dating rocks.

Living creatures do not stay the same. They evolve (change) over millions of years and form different species. For instance, trilobites were a kind of animal very common around 500 million years ago. If a layer of rock in the UK contains a particular kind of trilobite, geologists can be fairly sure that it is about the same age as rocks with the same kind of trilobite found in Germany, or in the USA.

Different trilobite species

If geologists are going to use fossils to date rocks, they have to learn about the different species, and how to tell the difference between them. Geologists have worked out when these species of trilobites lived:

- *Trinucleus* and *Angelina* lived between 500 and 430 million years ago
- *Kettneraspis* and *Calymene* lived between 430 and 395 million years ago
- *Paradoxides* lived between 570 and 500 million years ago.

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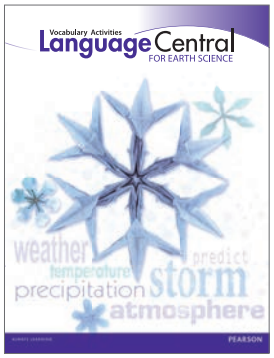

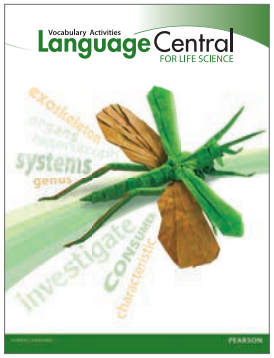

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Academic vocabulary support for English Language Learners

ELL

Language Central™ for Science helps English Language Learners (ELLs) and struggling students to develop the academic vocabulary necessary to master science. **Language Central™ for Science** is designed to directly address the issue of learning science vocabulary and to reinforce the instruction given in the science classroom.

- Helps ELL and struggling learners develop key academic science vocabulary.
- Reinforces the core instruction given in the science classroom.
- Provides reading, writing, speaking, and listening practice so students learn and apply academic vocabulary.

Language Central™ for Science is research-based and classroom-tested. Built by a team of ESL and content area teachers, it is full of rich exposure to vocabulary. The program embodies the five principles for teaching English language learners:

1) Identify and communicate content and language objectives
2) Frontload the lesson
3) Provide comprehensible input
4) Enable language production
5) Assess for content and language understanding.

Flexible and Topic-Based:

. . . a supplemental program of micro-modules that works with any Math or Science program out in the market. One hour per week OR 15 minutes per day, completes each 4-page lesson.

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Prevention over Intervention:

. . . supports students' language learning before intervention is needed. Brief, diagnostic checks, combined with leveled, scaffolded tasks keep students on track.

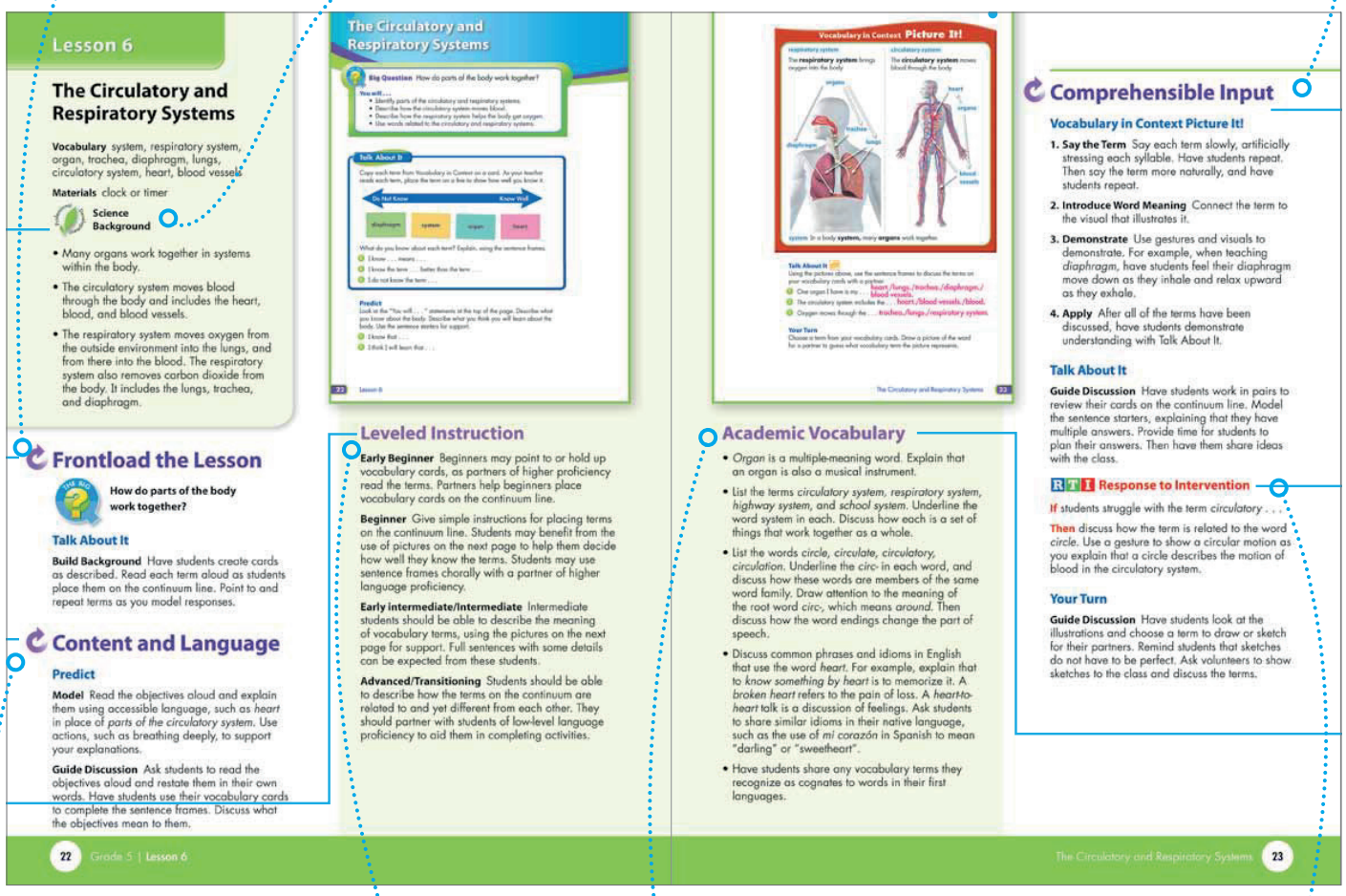
Collaborative Professional Development:

. . . a bridge between ELL and content area professionals, providing shared curriculum. It is organized by topics, within a "teach-what-you-need" design, with 24-27 lessons per year. It does not require a math or science background.

Frontload the Lesson Activities build background and connect to students' prior knowledge.

Science Background Communicate and clarify science concepts.

Comprehensible Input Visuals, demonstrations, and hands-on experiences improve understanding.



Lesson 6

The Circulatory and Respiratory Systems

Vocabulary system, respiratory system, organ, trachea, diaphragm, lungs, circulatory system, heart, blood vessels

Materials clock or timer

Science Background

- Many organs work together in systems within the body.
- The circulatory system moves blood through the body and includes the heart, blood, and blood vessels.
- The respiratory system moves oxygen from the outside environment into the lungs, and from there into the blood. The respiratory system also removes carbon dioxide from the body. It includes the lungs, trachea, and diaphragm.

Frontload the Lesson

How do parts of the body work together?

Talk About It

Build Background Have students create cards as described. Read each term aloud as students place them on the continuum line. Point to and repeat terms as you model responses.

Content and Language

Predict

Model Read the objectives aloud and explain them using accessible language, such as *heart* in place of *parts of the circulatory system*. Use actions, such as breathing deeply, to support your explanations.

Guide Discussion Ask students to read the objectives aloud and restate them in their own words. Have students use their vocabulary cards to complete the sentence frames. Discuss what the objectives mean to them.

The Circulatory and Respiratory Systems

Leveled Instruction

Early Beginner Beginners may point to or hold up vocabulary cards, as partners of higher proficiency read the terms. Partners help beginners place vocabulary cards on the continuum line.

Beginner Give simple instructions for placing terms on the continuum line. Students may benefit from the use of pictures on the next page to help them decide how well they know the terms. Students may use sentence frames chorally with a partner of higher language proficiency.

Early Intermediate/Intermediate Intermediate students should be able to describe the meaning of vocabulary terms, using the pictures on the next page for support. Full sentences with some details can be expected from these students.

Advanced/Transitioning Students should be able to describe how the terms on the continuum are related to and yet different from each other. They should partner with students of low-level language proficiency to aid them in completing activities.

Vocabulary in Context **Picture It!**

Academic Vocabulary

- *Organ* is a multiple-meaning word. Explain that an organ is also a musical instrument.
- List the terms *circulatory system, respiratory system, highway system,* and *school system*. Underline the word system in each. Discuss how each is a set of things that work together as a whole.
- List the words *circle, circulate, circulatory, circulation*. Underline the *circ-* in each word, and discuss how these words are members of the same word family. Draw attention to the meaning of the root word *circ-*, which means *around*. Then discuss how the word endings change the part of speech.
- Discuss common phrases and idioms in English that use the word *heart*. For example, explain that to *know something by heart* is to memorize it. A *broken heart* refers to the pain of loss. A *heart-to-heart* talk is a discussion of feelings. Ask students to share similar idioms in their native language, such as the use of *mi corazón* in Spanish to mean "darling" or "sweetheart".
- Have students share any vocabulary terms they recognize as cognates to words in their first languages.

Comprehensible Input

Vocabulary in Context Picture It!

1. **Say the Term** Say each term slowly, artificially stressing each syllable. Have students repeat. Then say the term more naturally, and have students repeat.
2. **Introduce Word Meaning** Connect the term to the visual that illustrates it.
3. **Demonstrate** Use gestures and visuals to demonstrate. For example, when teaching *diaphragm*, have students feel their diaphragm move down as they inhale and relax upward as they exhale.
4. **Apply** After all of the terms have been discussed, have students demonstrate understanding with Talk About It.

Talk About It

Guide Discussion Have students work in pairs to review their cards on the continuum line. Model the sentence starters, explaining that they have multiple answers. Provide time for students to plan their answers. Then have them share ideas with the class.

RTI Response to Intervention

If students struggle with the term *circulatory* . . .

Then discuss how the term is related to the word *circle*. Use a gesture to show a circular motion as you explain that a circle describes the motion of blood in the circulatory system.

Your Turn

Guide Discussion Have students look at the illustrations and choose a term to draw or sketch for their partners. Remind students that sketches do not have to be perfect. Ask volunteers to show sketches to the class and discuss the terms.

22 Grade 5 | Lesson 6

The Circulatory and Respiratory Systems 23

Sample pages from *Teacher Edition*

Content and Language Modeling and discussion clarify content and language objectives.

Academic Vocabulary Provides common language misconceptions and cultural differences for science vocabulary terms.

Leveled Instruction Teaching strategies accommodate all levels of English language proficiency.

Intervention "If/Then" statements help monitor progress and provide reteaching suggestions.

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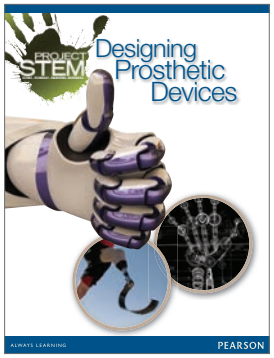


Project STEM ©2012

Today's students...Tomorrow's innovators!

Project STEM provides research-based materials that make it easy for you to integrate Science, Technology, Engineering, and Math (STEM) seamlessly into existing curricula and instruction. Continuing on from the 12 **Project STEM** topics available for grades K-5, **Project STEM 6-8** works with any middle grades science program. The six topics cover Life, Earth, and Physical sciences and illustrate how the four STEM areas are connected through hands-on labs, projects, and background materials.

- Seamlessly integrates STEM into your existing curricula – with program guides that eliminate the guesswork and provide all the needed support.
- Gives students a chance to practice innovation and teamwork through project-based learning, preparing them for a broader array of career options.
- Provides regular opportunities for students to practice scientific inquiry along with the engineering design process.
- Improves students' critical thinking skills as well as their ability to think creatively.

Introduction

Breathing in Space

What would it be like to live in space? Imagine floating from room to room. Picture looking out your window and seeing Earth below you. But how would you breathe? There is no oxygen in space and people cannot live without oxygen. The crew of the International Space Station generates their own oxygen. How do they do this? They have a machine that separates oxygen out of water. What happens if the machine breaks? How do the astronauts breathe? In case of emergency, the space station also stores large tanks of oxygen. These tanks can be used while the astronauts repair their oxygen machine.

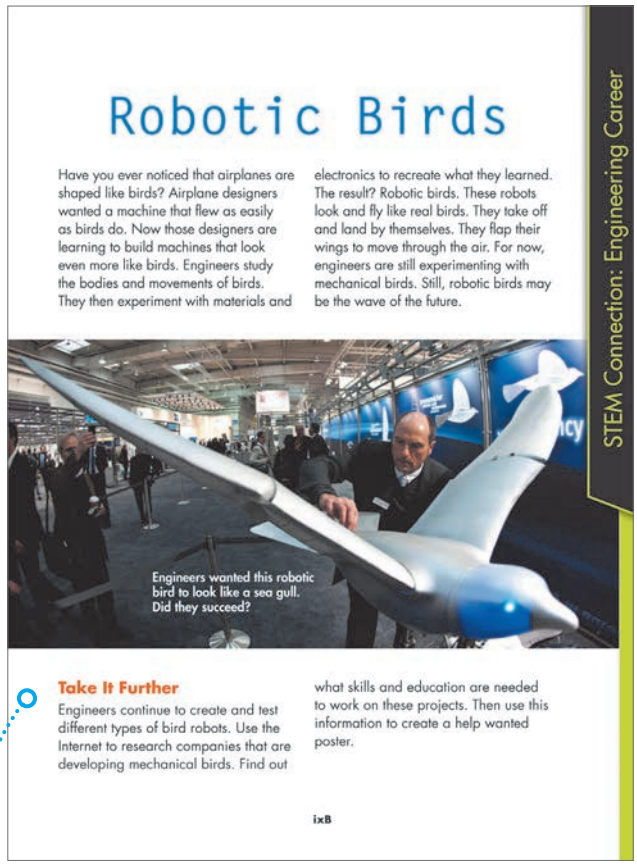
Take It Further

Go to the NASA International Space Station website, multimedia page, and click on "3D Resources." Navigate to the Station Spacewalk Game. Read the instructions and then play the game. Can you complete your mission before you run out of oxygen?

The International Space Station uses a machine to generate oxygen. On Earth, oxygen is released by plants. What are the benefits of each oxygen source? What are the challenges?

viii5

Sample page from **Project STEM** *Building for Earthquakes & Designing Space Vehicles Student Edition*


STEM Connection: Engineering Career

Robotic Birds

Have you ever noticed that airplanes are shaped like birds? Airplane designers wanted a machine that flew as easily as birds do. Now those designers are learning to build machines that look even more like birds. Engineers study the bodies and movements of birds. They then experiment with materials and electronics to recreate what they learned. The result? Robotic birds. These robots look and fly like real birds. They take off and land by themselves. They flap their wings to move through the air. For now, engineers are still experimenting with mechanical birds. Still, robotic birds may be the wave of the future.

Engineers wanted this robotic bird to look like a sea gull. Did they succeed?

Take It Further

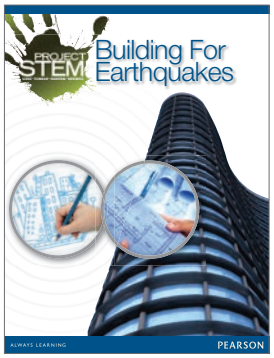
Engineers continue to create and test different types of bird robots. Use the Internet to research companies that are developing mechanical birds. Find out what skills and education are needed to work on these projects. Then use this information to create a help wanted poster.

ix8

Sample page from **Project STEM** *Rollercoaster Design Materials Kit*

The Big Question at the start of each module captures students' attention based on the topic of the booklet.

STEM Connections give students a chance to practice innovation and teamwork through project-based learning, preparing them for a broader array of career options.



Online Digital Path

Simplifies and supports integrated planning

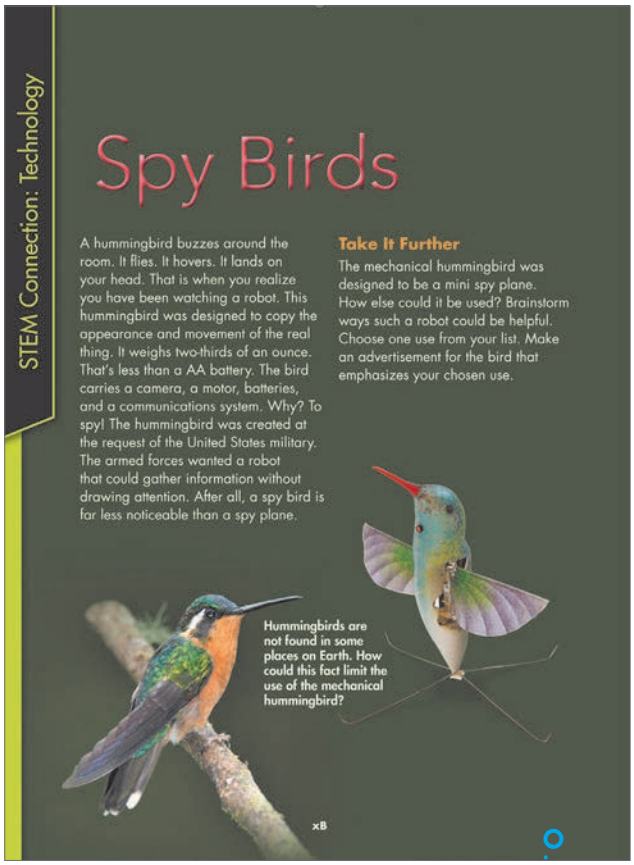
The integrated curriculum infuses reading, writing, and math practice with scientific inquiry and the engineering design process. Teachers can actually save time in their instruction by supporting the Common Core curriculum in this project based approach.

Develops confident, critical thinkers

Students' natural interests in science and engineering blossom through both real-world engineering design problems and hands-on inquiry. The activities and assessments promote higher-order, critical thinking skills that will result in improved student performance.

Empowers teachers

Through confidence-building professional development and the project-based instructional approach, **Project STEM** empowers teachers to raise expectations and improve student performance. In an area where teachers often lack training and confidence, **Project STEM** guides and supports teachers in developing the tools and confidence they need to be successful.



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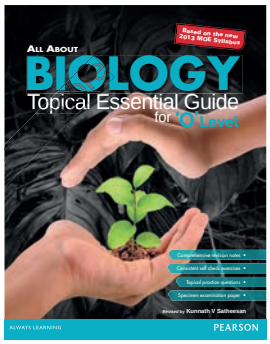

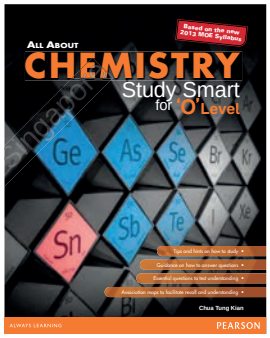

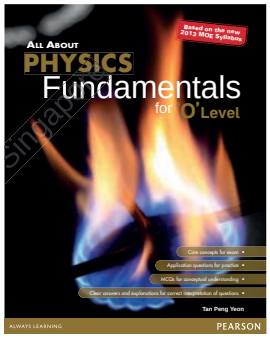

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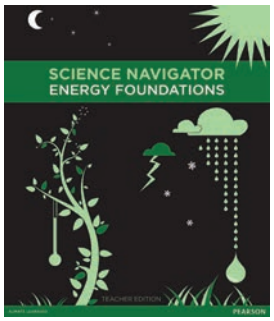

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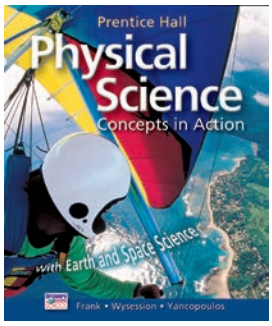

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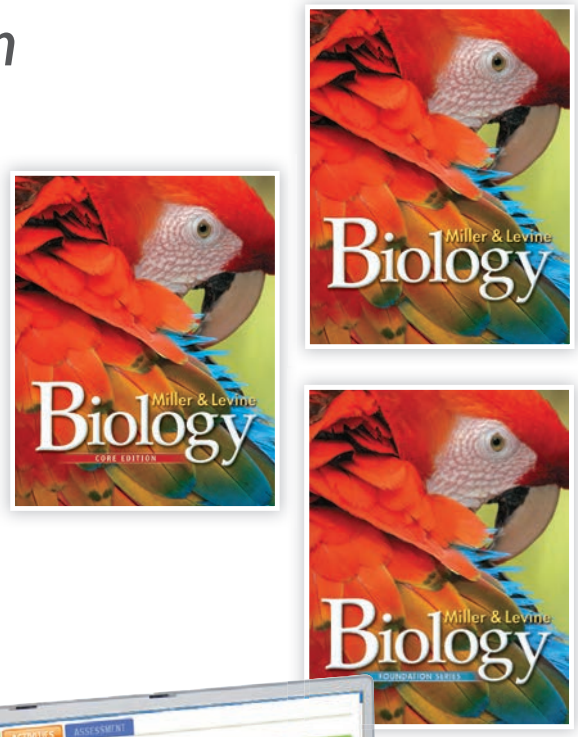

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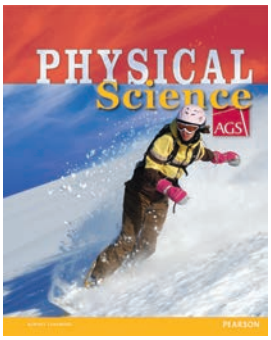

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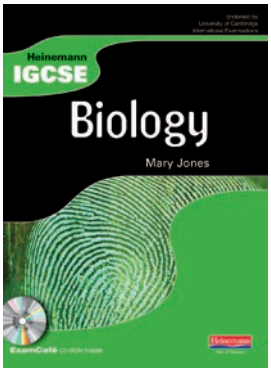

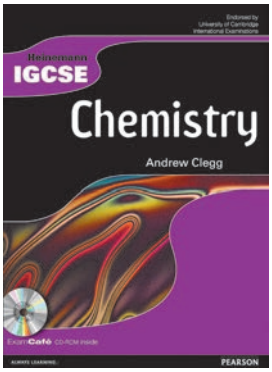

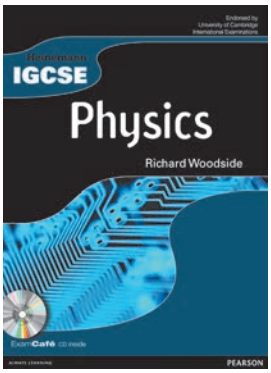

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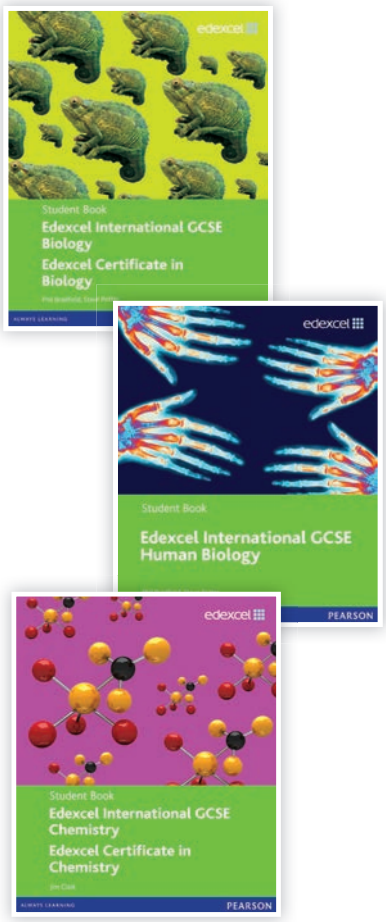

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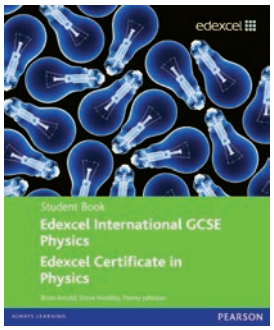

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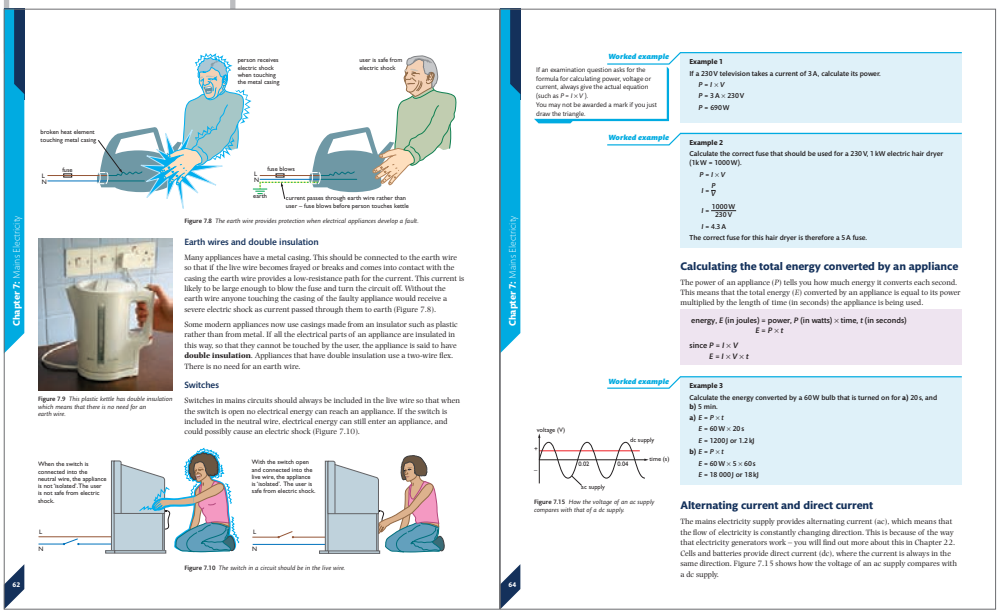

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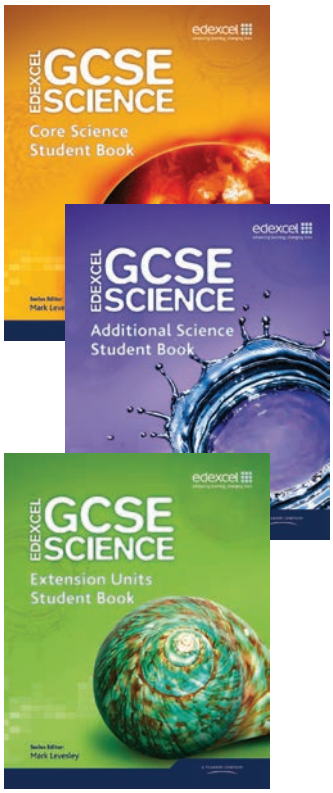

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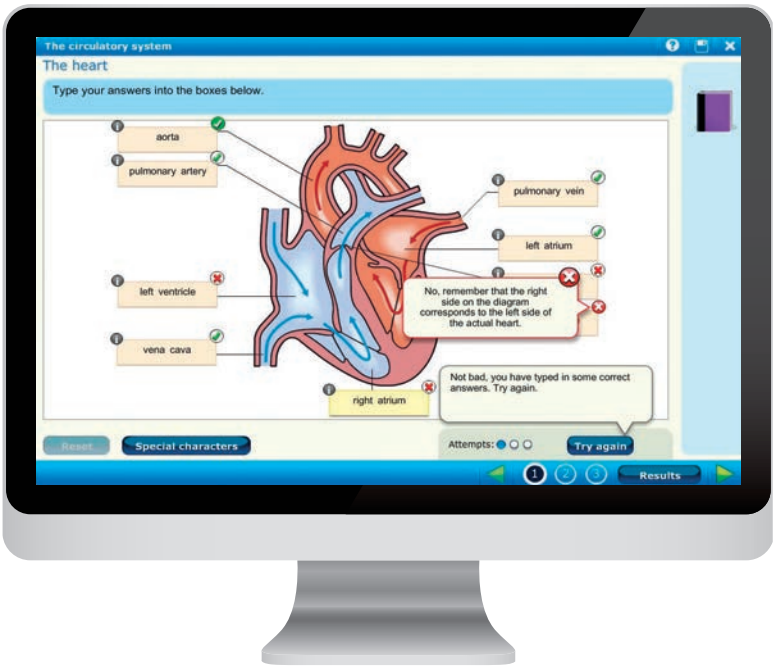

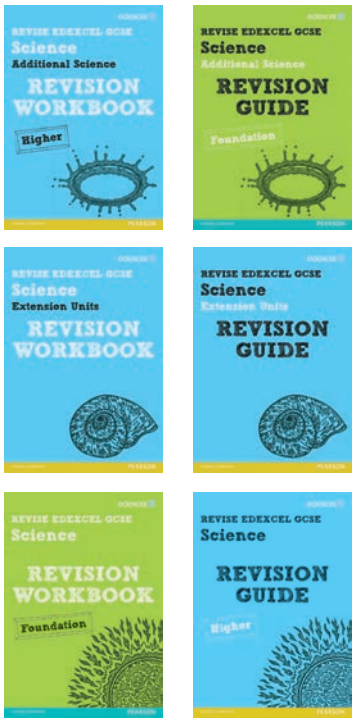

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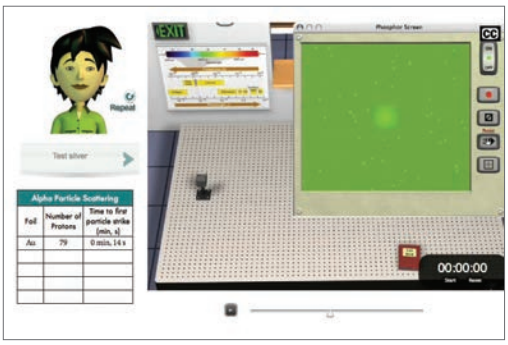

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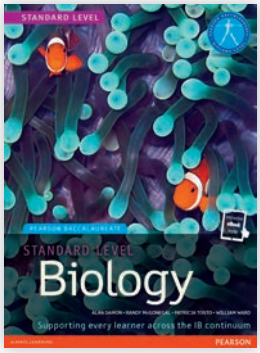	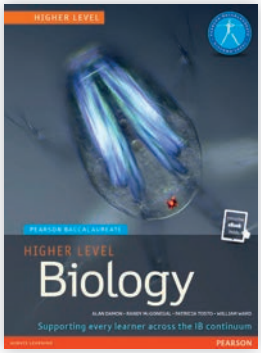
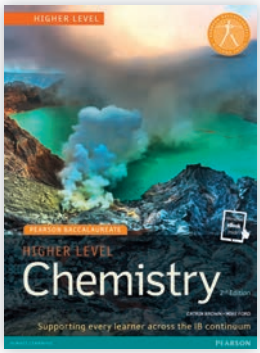	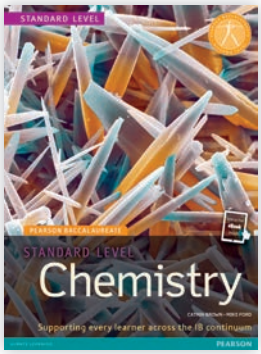
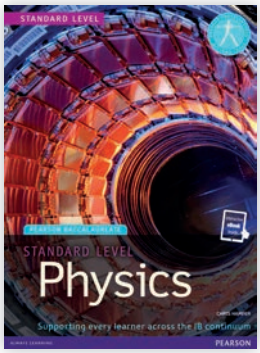	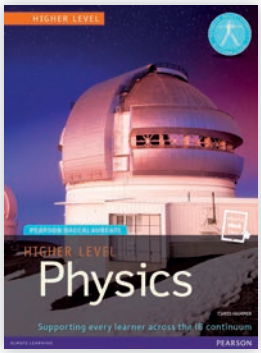

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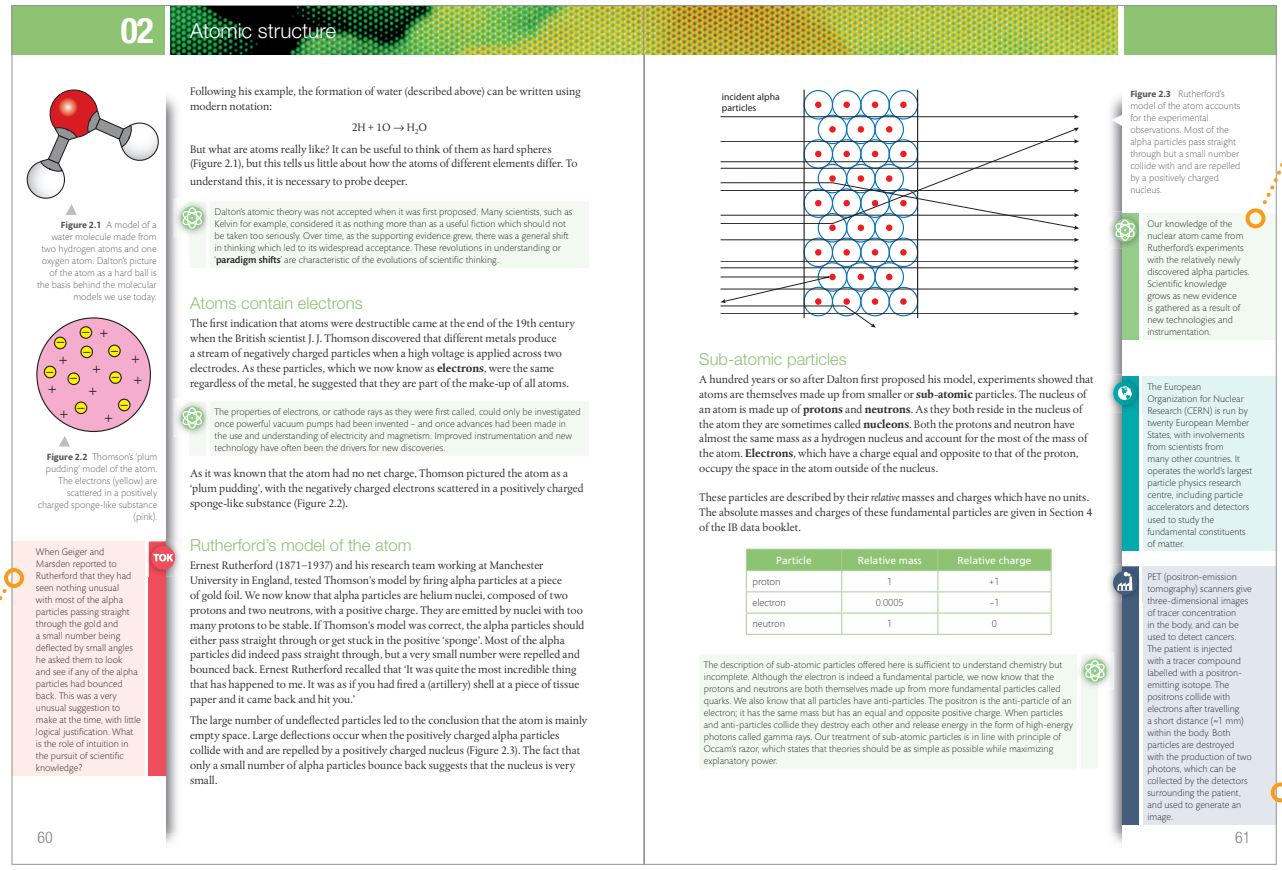

02 Atomic structure

Figure 2.1 A model of a water molecule made from two hydrogen atoms and one oxygen atom. Dalton's picture of the atom as a hard ball is the basis behind the molecular models we use today.

Figure 2.2 Thomson's 'plum pudding' model of the atom. The electrons (yellow) are scattered in a positively charged sponge-like substance (pink).

When Geiger and Marsden reported to Rutherford that they had seen nothing unusual with most of the alpha particles passing straight through the gold and a small number being deflected by small angles he asked them to look and see if any of the alpha particles had bounced back. This was a very unusual suggestion to make at the time, with little logical justification. What is the role of intuition in the pursuit of scientific knowledge?

TOK

Following his example, the formation of water (described above) can be written using modern notation:

$$2H + 1O \rightarrow H_2O$$

But what are atoms really like? It can be useful to think of them as hard spheres (Figure 2.1), but this tells us little about how the atoms of different elements differ. To understand this, it is necessary to probe deeper.

Dalton's atomic theory was not accepted when it was first proposed. Many scientists, such as Kelvin for example, considered it as nothing more than as a useful fiction which should not be taken too seriously. Over time, as the supporting evidence grew, there was a general shift in thinking which led to its widespread acceptance. These revolutions in understanding or **paradigm shifts** are characteristic of the evolutions of scientific thinking.

Atoms contain electrons

The first indication that atoms were destructible came at the end of the 19th century when the British scientist J. J. Thomson discovered that different metals produce a stream of negatively charged particles when a high voltage is applied across two electrodes. As these particles, which we now know as **electrons**, were the same regardless of the metal, he suggested that they are part of the make-up of all atoms.

The properties of electrons, or cathode rays as they were first called, could only be investigated once powerful vacuum pumps had been invented – and once advances had been made in the use and understanding of electricity and magnetism. Improved instrumentation and new technology have often been the drivers for new discoveries.

As it was known that the atom had no net charge, Thomson pictured the atom as a 'plum pudding', with the negatively charged electrons scattered in a positively charged sponge-like substance (Figure 2.2).

Rutherford's model of the atom

Ernest Rutherford (1871–1937) and his research team working at Manchester University in England, tested Thomson's model by firing alpha particles at a piece of gold foil. We now know that alpha particles are helium nuclei, composed of two protons and two neutrons, with a positive charge. They are emitted by nuclei with too many protons to be stable. If Thomson's model was correct, the alpha particles should either pass straight through or get stuck in the positive 'sponge'. Most of the alpha particles did indeed pass straight through, but a very small number were repelled and bounced back. Ernest Rutherford recalled that 'It was quite the most incredible thing that has happened to me. It was as if you had fired a (artillery) shell at a piece of tissue paper and it came back and hit you.'

The large number of undeflected particles led to the conclusion that the atom is mainly empty space. Large deflections occur when the positively charged alpha particles collide with and are repelled by a positively charged nucleus (Figure 2.3). The fact that only a small number of alpha particles bounce back suggests that the nucleus is very small.

60

Figure 2.3 Rutherford's model of the atom accounts for the experimental observations. Most of the alpha particles pass straight through but a small number collide with and are repelled by a positively charged nucleus.

Our knowledge of the nuclear atom came from Rutherford's experiments with the relatively newly discovered alpha particles. Scientific knowledge grows as new evidence is gathered as a result of new technologies and instrumentation.

Sub-atomic particles

A hundred years or so after Dalton first proposed his model, experiments showed that atoms are themselves made up from smaller or **sub-atomic** particles. The nucleus of an atom is made up of **protons** and **neutrons**. As they both reside in the nucleus of the atom they are sometimes called **nucleons**. Both the protons and neutron have almost the same mass as a hydrogen nucleus and account for the most of the mass of the atom. **Electrons**, which have a charge equal and opposite to that of the proton, occupy the space in the atom outside of the nucleus.

These particles are described by their *relative* masses and charges which have no units. The absolute masses and charges of these fundamental particles are given in Section 4 of the IB data booklet.

Particle	Relative mass	Relative charge
proton	1	+1
electron	0.0005	−1
neutron	1	0

The description of sub-atomic particles offered here is sufficient to understand chemistry but incomplete. Although the electron is indeed a fundamental particle, we now know that the protons and neutrons are both themselves made up from more fundamental particles called quarks. We also know that all particles have anti-particles. The positron is the anti-particle of an electron; it has the same mass but has an equal and opposite positive charge. When particles and anti-particles collide they destroy each other and release energy in the form of high-energy photons called gamma rays. Our treatment of sub-atomic particles is in line with principle of Occam's razor, which states that theories should be as simple as possible while maximizing explanatory power.

The European Organization for Nuclear Research (CERN) is run by twenty European Member States, with involvements from scientists from many other countries. It operates the world's largest particle physics research centre, including particle accelerators and detectors used to study the fundamental constituents of matter.

PET (positron-emission tomography) scanners give three-dimensional images of tracer concentration in the body, and can be used to detect cancers. The patient is injected with a tracer compound labelled with a positron-emitting isotope. The positrons collide with electrons after travelling a short distance (≈1 mm) within the body. Both particles are destroyed with the production of two photons, which can be collected by the detectors surrounding the patient, and used to generate an image.

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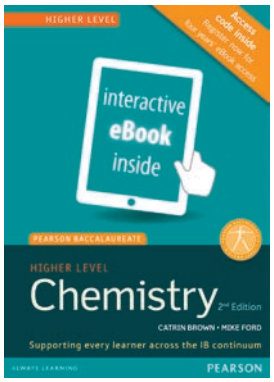
Sample pages from **Higher Level Chemistry**

Theory of Knowledge
Clear and imaginative links to Theory of Knowledge - of interest to the student as an individual, and easily integrated into classroom discussion.

Utilization
Utilization boxes support the new curriculum aims to provide synoptic links to other areas of science, as well as examples of a variety of real-world applications.



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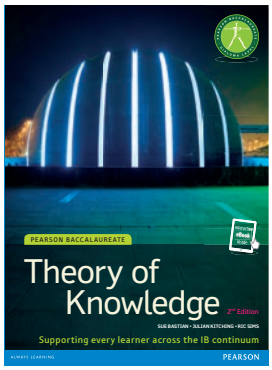

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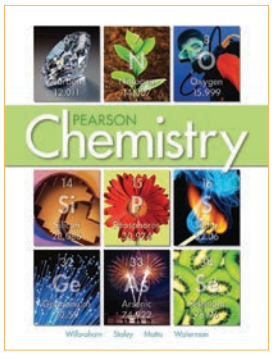

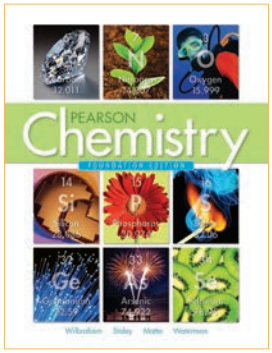

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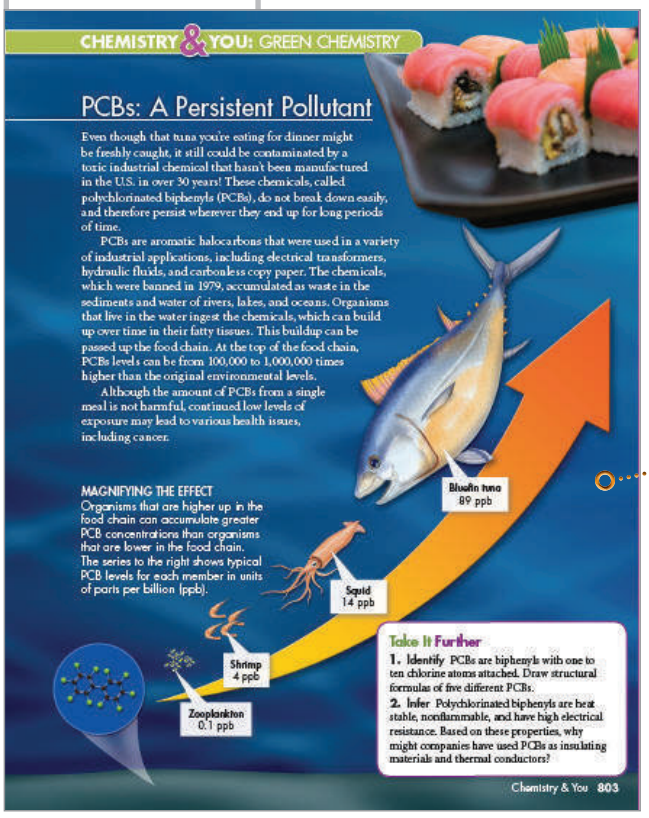

CHEMISTRY & YOU: GREEN CHEMISTRY

PCBs: A Persistent Pollutant

Even though that tuna you're eating for dinner might be freshly caught, it still could be contaminated by a toxic industrial chemical that hasn't been manufactured in the U.S. in over 30 years! These chemicals, called polychlorinated biphenyls (PCBs), do not break down easily, and therefore persist wherever they end up for long periods of time.

PCBs are aromatic halocarbons that were used in a variety of industrial applications, including electrical transformers, hydraulic fluids, and carbonless copy paper. The chemicals, which were banned in 1979, accumulated as waste in the sediments and water of rivers, lakes, and oceans. Organisms that live in the water ingest the chemicals, which can build up over time in their fatty tissues. This buildup can be passed up the food chain. At the top of the food chain, PCBs levels can be from 100,000 to 1,000,000 times higher than the original environmental levels.

Although the amount of PCBs from a single meal is not harmful, continued low levels of exposure may lead to various health issues, including cancer.

MAGNIFYING THE EFFECT
Organisms that are higher up in the food chain can accumulate greater PCB concentrations than organisms that are lower in the food chain. The series to the right shows typical PCB levels for each member in units of parts per billion (ppb).

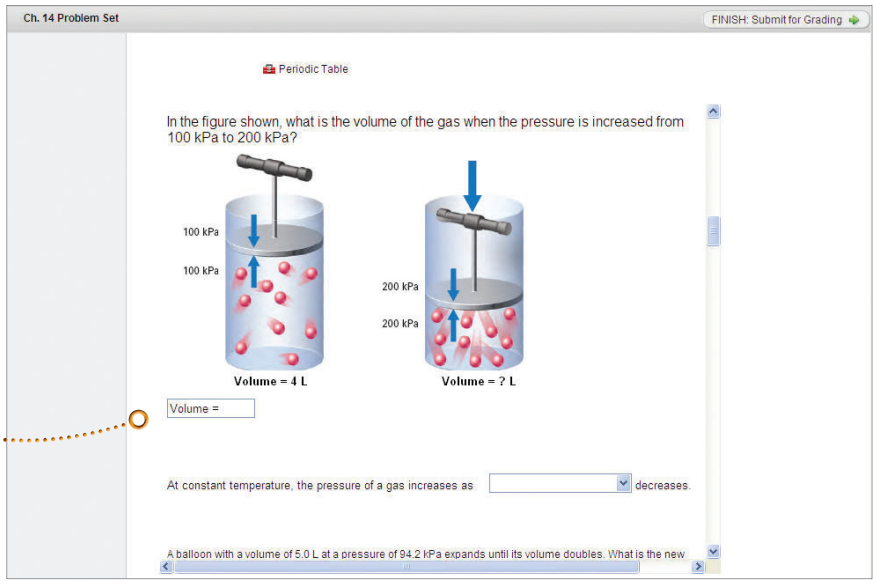
Bluefin tuna 89 ppb
Squid 14 ppb
Shrimp 4 ppb
Zooplankton 0.1 ppb

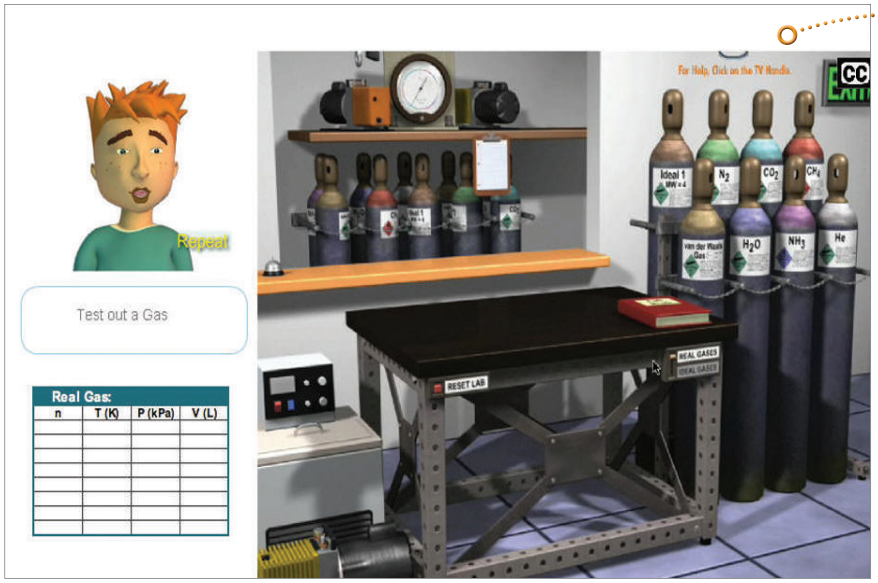
Take It Further
1. Identify PCBs are biphenyls with one to ten chlorine atoms attached. Draw structural formulas of five different PCBs.
2. Infer Polychlorinated biphenyls are heat stable, nonflammable, and have high electrical resistance. Based on these properties, why might companies have used PCBs as insulating materials and thermal conductors?

Chemistry & You 803

The on-level and foundation *Student Editions* contain the same content base, but the *Foundation Edition* includes an extra emphasis on math and reading support to meet the needs of all your students.

PearsonChem.com Provides cutting-edge digital content that engages students and teachers – anytime, anywhere, with numerous practice opportunities and visual support, including interactive art and animations. Online tutors step students through chemistry and math problems, expanding learning beyond the classroom.





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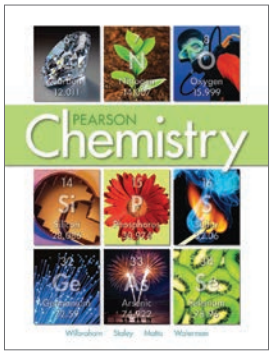
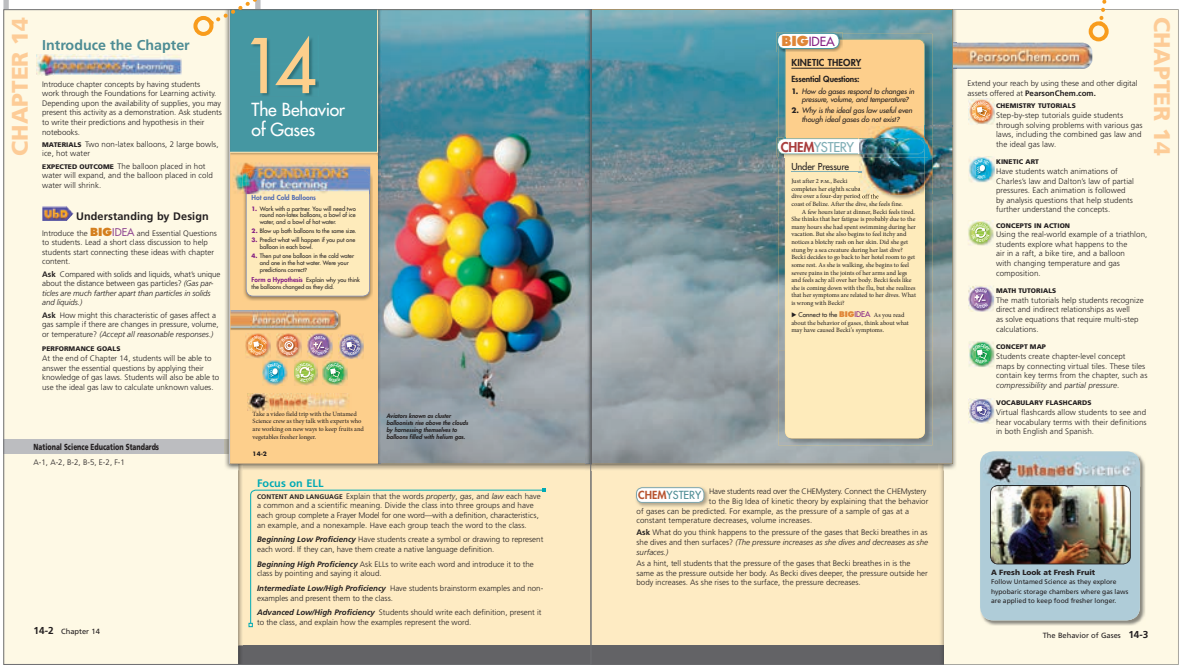


Pearson Chemistry helps you meet the unique learning styles of each student in your classroom with a variety of resources.

The online *Teacher Edition* helps bring concepts to life, along with a comprehensive Teacher Center, digital lessons, interactive animations, simulations and assessments - all in one handy place.

Teacher Edition



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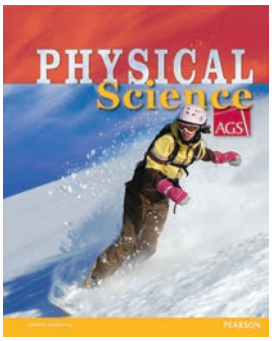

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See page 44 for full details

Edexcel GCE Sciences

Edexcel's own resources for the 2008 GCE specifications

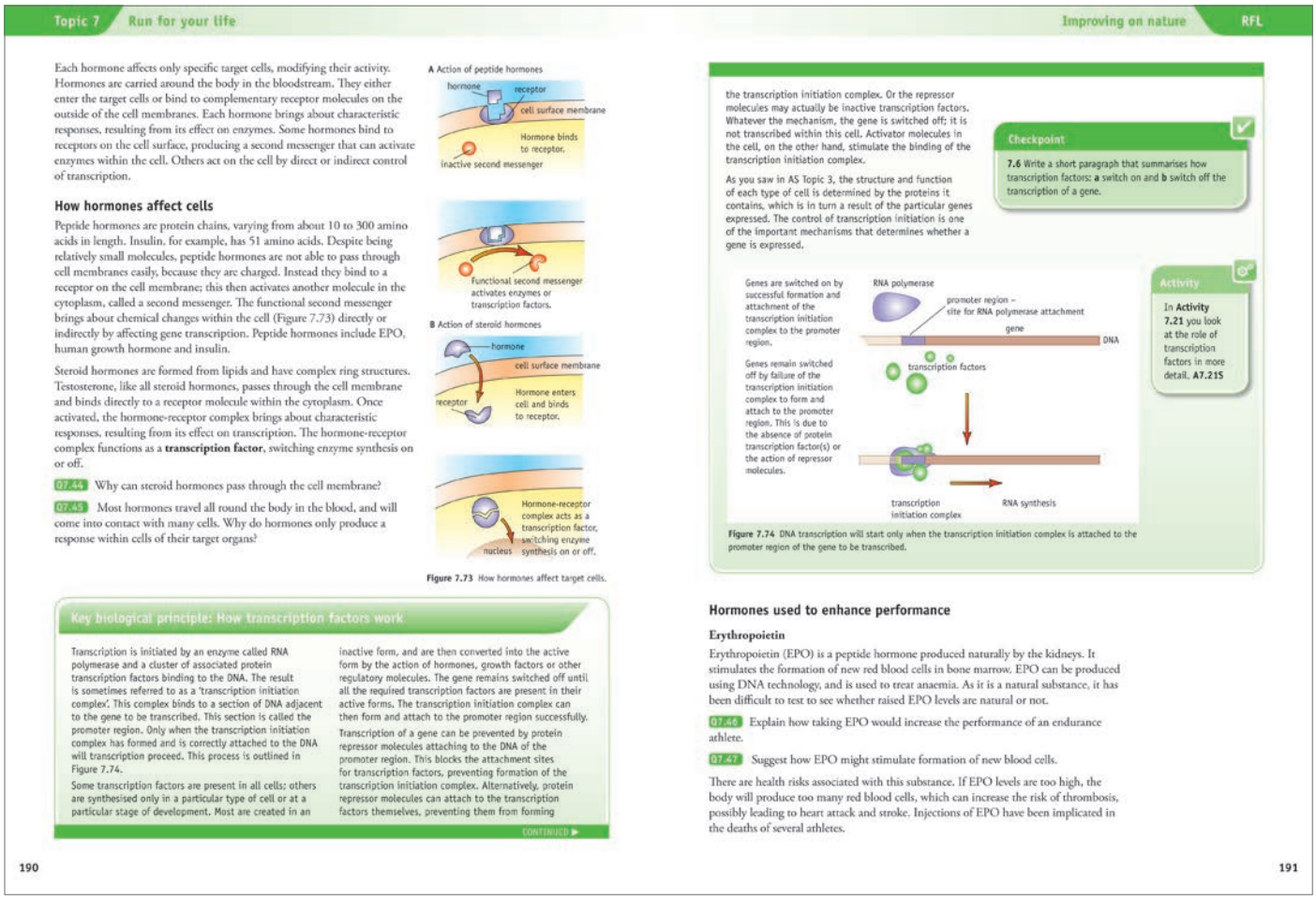
NEW COMPONENTS

Developed to support context- and concept-led approaches, our new resources promote success and facilitate planning in GCE Science.

Context-led resources:

Salters-Nuffield Advanced Biology and Salters-Horners Advanced Physics

Salters-Nuffield Advanced Biology (SNAB) and **Salters-Horners Advanced Physics** (SHAP) are complete courses with their own distinctive philosophy. Developed by the SHAP and SNAB teams at the University of York Science Education Group and Nuffield Curriculum Centre, they cover biology and physics through real-life contexts, combining the key concepts underpinning science today with the opportunity to gain the wider skills that biologists and physicists now need.



Topic 7 Run for your life

Each hormone affects only specific target cells, modifying their activity. Hormones are carried around the body in the bloodstream. They either enter the target cells or bind to complementary receptor molecules on the outside of the cell membranes. Each hormone brings about characteristic responses, resulting from its effect on enzymes. Some hormones bind to receptors on the cell surface, producing a second messenger that can activate enzymes within the cell. Others act on the cell by direct or indirect control of transcription.

How hormones affect cells

Peptide hormones are protein chains, varying from about 10 to 300 amino acids in length. Insulin, for example, has 51 amino acids. Despite being relatively small molecules, peptide hormones are not able to pass through cell membranes easily, because they are charged. Instead they bind to a receptor on the cell membrane; this then activates another molecule in the cytoplasm, called a second messenger. The functional second messenger brings about chemical changes within the cell (Figure 7.73) directly or indirectly by affecting gene transcription. Peptide hormones include EPO, human growth hormone and insulin.

Steroid hormones are formed from lipids and have complex ring structures. Testosterone, like all steroid hormones, passes through the cell membrane and binds directly to a receptor molecule within the cytoplasm. Once activated, the hormone-receptor complex brings about characteristic responses, resulting from its effect on transcription. The hormone-receptor complex functions as a **transcription factor**, switching enzyme synthesis on or off.

07.44 Why can steroid hormones pass through the cell membrane?

07.45 Most hormones travel all round the body in the blood, and will come into contact with many cells. Why do hormones only produce a response within cells of their target organs?

A Action of peptide hormones

hormone
receptor
cell surface membrane
Hormone binds to receptor.
inactive second messenger
Functional second messenger activates enzymes or transcription factors.

B Action of steroid hormones

hormone
cell surface membrane
receptor
Hormone enters cell and binds to receptor.
Hormone-receptor complex acts as a transcription factor, switching enzyme synthesis on or off.
nucleus

Figure 7.73 How hormones affect target cells.

Key biological principle: How transcription factors work

Transcription is initiated by an enzyme called RNA polymerase and a cluster of associated protein transcription factors binding to the DNA. The result is sometimes referred to as a 'transcription initiation complex'. This complex binds to a section of DNA adjacent to the gene to be transcribed. This section is called the promoter region. Only when the transcription initiation complex has formed and is correctly attached to the DNA will transcription proceed. This process is outlined in Figure 7.74.

Some transcription factors are present in all cells; others are synthesised only in a particular type of cell or at a particular stage of development. Most are created in an inactive form, and are then converted into the active form by the action of hormones, growth factors or other regulatory molecules. The gene remains switched off until all the required transcription factors are present in their active forms. The transcription initiation complex can then form and attach to the promoter region successfully.

Transcription of a gene can be prevented by protein repressor molecules attaching to the DNA of the promoter region. This blocks the attachment sites for transcription factors, preventing formation of the transcription initiation complex. Alternatively, protein repressor molecules can attach to the transcription factors themselves, preventing them from forming

CONTINUED ▶

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Improving on nature RFL

the transcription initiation complex. Or the repressor molecules may actually be inactive transcription factors. Whatever the mechanism, the gene is switched off; it is not transcribed within this cell. Activator molecules in the cell, on the other hand, stimulate the binding of the transcription initiation complex.

As you saw in AS Topic 3, the structure and function of each type of cell is determined by the proteins it contains, which is in turn a result of the particular genes expressed. The control of transcription initiation is one of the important mechanisms that determines whether a gene is expressed.

Checkpoint

7.6 Write a short paragraph that summarises how transcription factors: **a** switch on and **b** switch off the transcription of a gene.

Genes are switched on by successful formation and attachment of the transcription initiation complex to the promoter region.

Genes remain switched off by failure of the transcription initiation complex to form and attach to the promoter region. This is due to the absence of protein transcription factor(s) or the action of repressor molecules.

RNA polymerase
promoter region – site for RNA polymerase attachment
gene
DNA
transcription factors
transcription initiation complex
RNA synthesis

Activity

In **Activity 7.21** you look at the role of transcription factors in more detail. A7.21S

Figure 7.74 DNA transcription will start only when the transcription initiation complex is attached to the promoter region of the gene to be transcribed.

Hormones used to enhance performance

Erythropoietin

Erythropoietin (EPO) is a peptide hormone produced naturally by the kidneys. It stimulates the formation of new red blood cells in bone marrow. EPO can be produced using DNA technology, and is used to treat anaemia. As it is a natural substance, it has been difficult to test to see whether raised EPO levels are natural or not.

07.46 Explain how taking EPO would increase the performance of an endurance athlete.

07.47 Suggest how EPO might stimulate formation of new blood cells.

There are health risks associated with this substance. If EPO levels are too high, the body will produce too many red blood cells, which can increase the risk of thrombosis, possibly leading to heart attack and stroke. Injections of EPO have been implicated in the deaths of several athletes.

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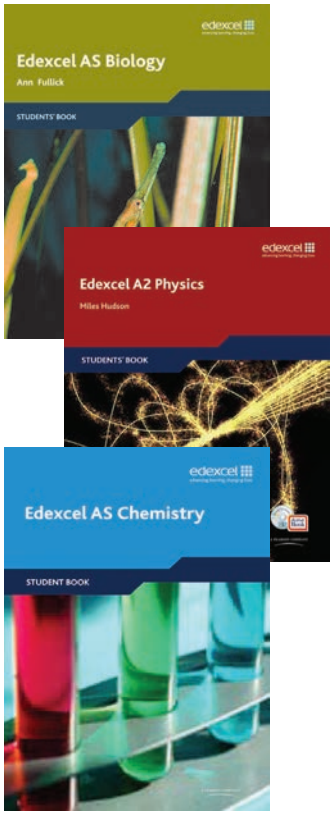
Sample pages from **Salters-Nuffield Advanced Biology**



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NEW

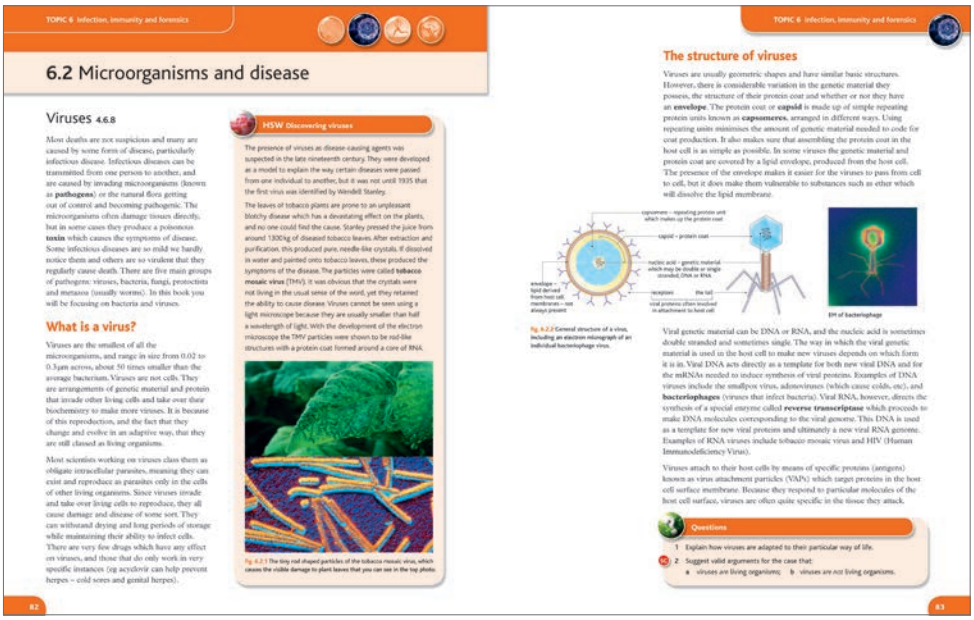
New GCE Science specifications start teaching from September 2015. See page 64 for details of our new course being produced to support these new qualifications.

See page 63 for a complete list of components

Concept-led resources:

Edexcel GCE Biology, Chemistry and Physics

The concept-led approach to Edexcel GCE Sciences provides students with an in-depth understanding of the principles covered whilst studying a particular topic. It usually begins with the study of the theories and models of the individual sciences and finishes with an exploration of their practical applications.



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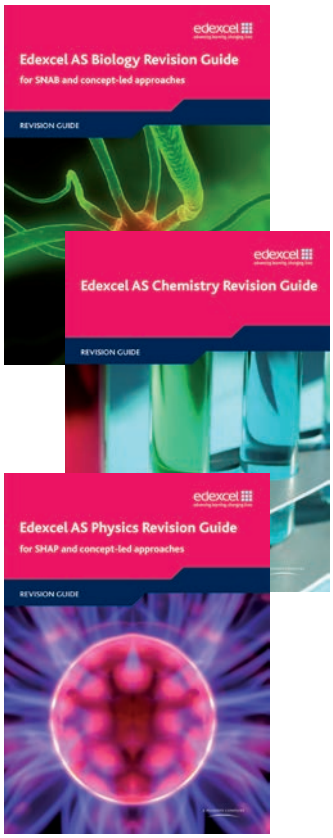


Revision Guides to support the core course materials

Suitable for both concept- and context-led approaches, these *Revision Guides* are Edexcel's own resources for the 2008 science specifications. Written by experienced examiners, they feature guidance from the people who write and mark exam papers and draw on real exam data from Edexcel's ResultsPlus service.

- ResultsPlus examiner feedback draws on examiner expertise and real past exam data to help students avoid common pitfalls and build better answers.
- Exam-style questions, including multiple-choice style, offer plenty of practice ahead of the exam.
- Worked examples provide step-by-step guidance on how to tackle exam questions.

Revision Guide

Unit 5: Exercise and Coordination

Unit 5 specimen paper

1 Muscle paralysis is common in many cases of poisoning, often as a result of interference with chemical transmission from the motor neurones to the muscles at the neuromuscular junctions. Studies of venomous snakes, such as the Prugasti krait (*Bungarus fasciatus*) have played a part in the investigation of this chemical transmission.

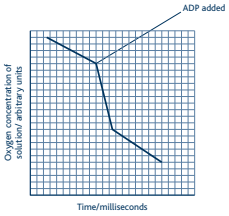
(a) Describe the normal sequence of events that occurs **within a muscle fibre** after stimulation of a neuromuscular junction. (5)

(b) Bungaratoxin can be isolated from the venom of the Prugasti krait. In minute amounts, it can cause paralysis of the diaphragm and intercostal muscles by its effects at synapses. Suggest how bungaratoxin causes these effects. (3)

Total 8 marks

(Edexcel GCE Biology (Salters-Nuffield) Advanced Unit 5B June 2007)

2 Isolated mitochondria in a solution containing inorganic phosphate and an electron donor can be used to study respiration. An electrode is used to record changes in oxygen concentration while mitochondria respire. The graph shows changes in oxygen concentration for some isolated mitochondria.



(a) (i) Describe and explain the trends shown on the graph above. (3)

(ii) Name an electron donor used in the electron transport chain in mitochondria. (1)

(iii) State the location of the electron transport chain in mitochondria. (1)

(iv) Describe how ATP is synthesised in the electron transport chain. (4)

(b) ATP is used to provide an immediate supply of energy for biological processes. Describe the role of ATP in the following processes.

(i) nerve impulse transmission (2)

(ii) hyperpolarisation of rod cells in the retina. (2)

Total 13 marks

(Edexcel GCE Biology (Salters-Nuffield) Advanced Unit 5B June 2008)

3 (a) Explain what is meant by the Human Genome Project. (2)

(b) The Human Genome Project is making it possible to identify people who may be at risk of developing medical conditions such as heart disease, cancer and diabetes.

(i) Suggest *two* reasons why identifying people at risk might be of benefit to the people who are tested. (2)

(ii) Suggest *three* disadvantages or ethical objections posed by the Human Genome Project. (3)

Total 7 marks

(Edexcel GCE Biology (Salters-Nuffield) Advanced Unit 2 June 2005)

8

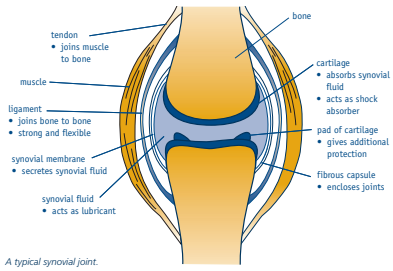
End of unit specimen papers provide essential exam practice.

5 **Unit 5:** Exercise and Coordination

Muscles and movement

Muscles, joints and movement

Bones can move in relation to one another at **joints**. Different types of joint allow different degrees of movement. **Ligaments** are made of elastic connective tissue. They hold bones together and restrict the amount of movement possible at a joint. **Tendons** are cords of non-elastic fibrous tissue that anchor muscles to bones.



A typical synovial joint.

ResultsPlus Examiner tip

Remember that muscles can't stretch themselves. It is the pull created by the contraction of the antagonistic muscle that stretches a muscle when it is in a relaxed state.

Skeletal muscles are those attached to bones and are normally arranged in **antagonistic pairs**. This means that there are pairs of muscles which pull in opposite directions. **Flexors** contract to flex, or bend a joint, e.g. biceps in the arm; **extensors** contract to extend, or straighten a joint, e.g. triceps in the arm.

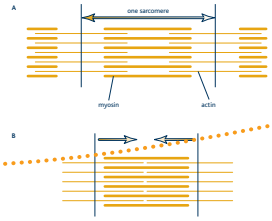
Each skeletal muscle is a bundle of millions of muscle cells called fibres. Each muscle cell may be several centimetres long and contains several nuclei. It contains many **myofibrils** which are made up of the fibrous proteins **actin** (thin filaments) and **myosin** (thick filaments). The cell surface membrane of a muscle cell is known as the **sarcolemma**. The **sarcoplasmic reticulum** is a specialised endoplasmic reticulum which can store and release calcium ions. The cytoplasm inside a muscle cell is called the **sarcoplasm**. The specialised synapse (see page 63, Topic 8) between neurones and muscle cells is called the **neuromuscular junction**.

ResultsPlus Examiner tip

The prefix myo- refers to 'muscle' and sarco- to 'flesh' (i.e. muscle) so specialist terms starting with myo- or sarco- will refer to structures within muscles.

The sliding filament theory of muscle contraction

The functional unit of a muscle fibre is called a sarcomere. When the muscle contracts the thin actin filaments move between the thick myosin filaments, shortening the length of the sarcomere and therefore shortening the length of the muscle.



The arrangement of actin and myosin filaments in a sarcomere when relaxed (A) and contracted (B).

44 Green Book 7.2 Orange Book 7.1

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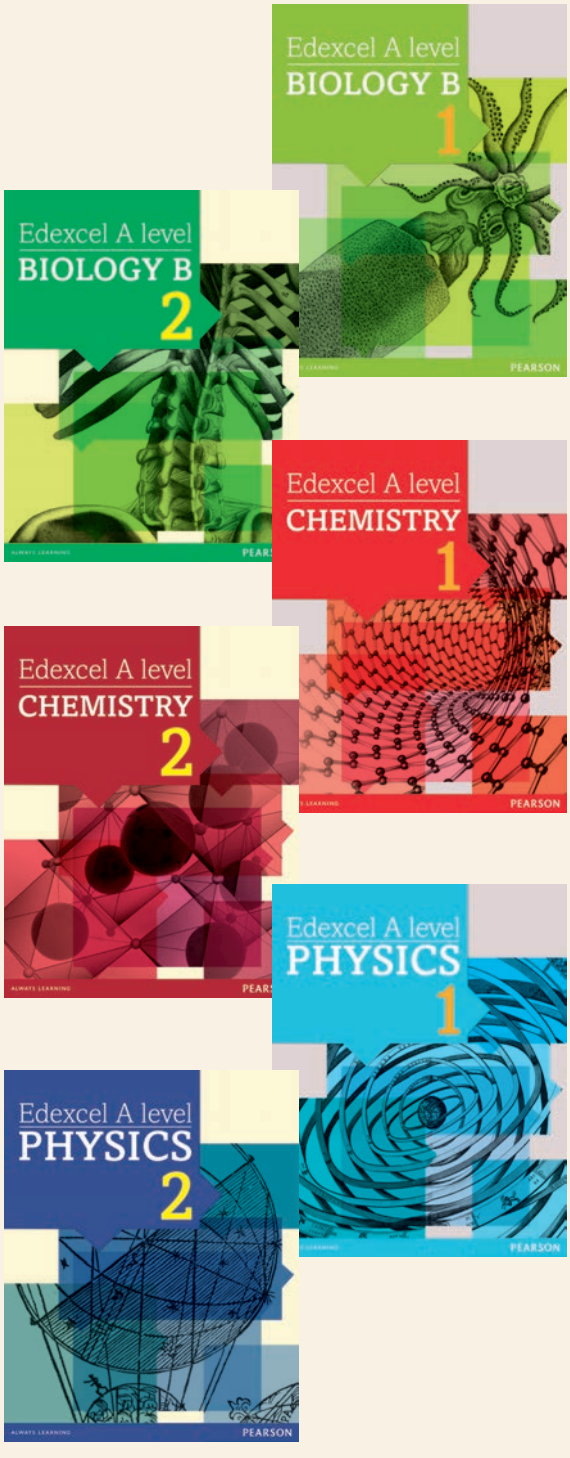

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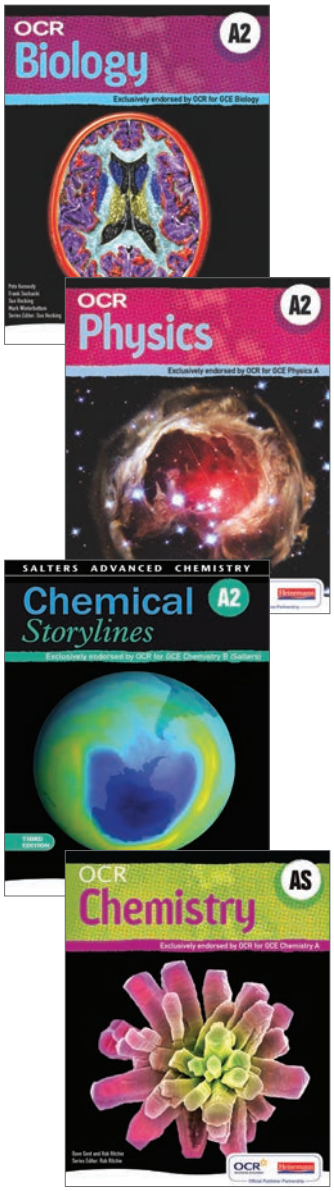

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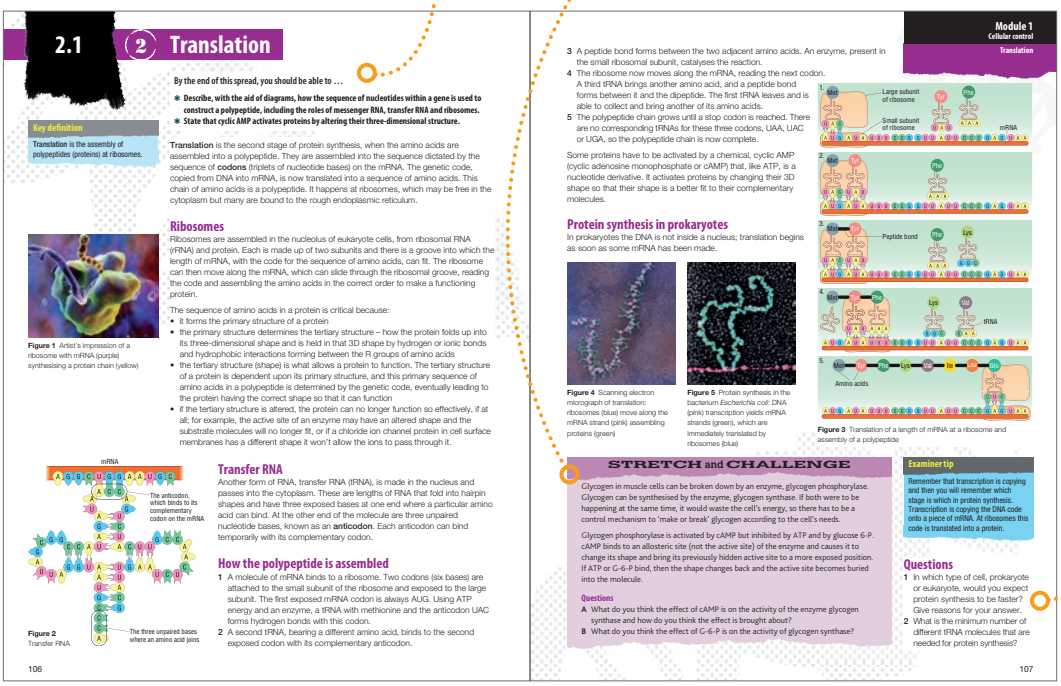

2.1 2 Translation

By the end of this spread, you should be able to …

* Describe, with the aid of diagrams, how the sequence of nucleotides within a gene is used to construct a polypeptide, including the roles of messenger RNA, transfer RNA and ribosomes.
* State that cyclic AMP activates proteins by altering their three-dimensional structure.

Key definition: Translation is the assembly of polypeptides (proteins) at ribosomes.

Translation is the second stage of protein synthesis, when the amino acids are assembled into a polypeptide. They are assembled into the sequence dictated by the sequence of codons (triplets of nucleotide bases) on the mRNA. The genetic code, copied from DNA into mRNA, is now translated into a sequence of amino acids. This chain of amino acids is a polypeptide. It happens at ribosomes, which may be free in the cytoplasm but many are bound to the rough endoplasmic reticulum.

Ribosomes

Ribosomes are assembled in the nucleolus of eukaryote cells, from ribosomal RNA (rRNA) and protein. Each is made up of two subunits and there is a groove into which the length of mRNA, with the code for the sequence of amino acids, can fit. The ribosome can then move along the mRNA, which can slide through the ribosomal groove, reading the code and assembling the amino acids in the correct order to make a functioning protein.

The sequence of amino acids in a protein is critical because:

- it forms the primary structure of a protein
- the primary structure determines the tertiary structure – how the protein folds up into its three-dimensional shape and is held in that 3D shape by hydrogen or ionic bonds and hydrophobic interactions forming between the R groups of amino acids
- the tertiary structure (shape) is what allows a protein to function. The tertiary structure of a protein is dependent upon its primary structure, and this primary sequence of amino acids in a polypeptide is determined by the genetic code, eventually leading to the protein having the correct shape so that it can function
- if the tertiary structure is altered, the protein can no longer function so effectively, if at all; for example, the active site of an enzyme may have an altered shape and the substrate molecules will no longer fit, or if a chloride ion channel protein in cell surface membranes has a different shape it won't allow the ions to pass through it.

Figure 1 Artist's impression of a ribosome with mRNA (purple) synthesising a protein chain (yellow)

Transfer RNA

Another form of RNA, transfer RNA (tRNA), is made in the nucleus and passes into the cytoplasm. These are lengths of RNA that fold into hairpin shapes and have three exposed bases at one end where a particular amino acid can bind. At the other end of the molecule are three unpaired nucleotide bases, known as an anticodon. Each anticodon can bind temporarily with its complementary codon.

How the polypeptide is assembled

1 A molecule of mRNA binds to a ribosome. Two codons (six bases) are attached to the small subunit of the ribosome and exposed to the large subunit. The first exposed mRNA codon is always AUG. Using ATP energy and an enzyme, a tRNA with methionine and the anticodon UAC forms hydrogen bonds with this codon.
2 A second tRNA, bearing a different amino acid, binds to the second exposed codon with its complementary anticodon.

Figure 2 Transfer RNA

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Module 1 Cellular control — Translation

3 A peptide bond forms between the two adjacent amino acids. An enzyme, present in the small ribosomal subunit, catalyses the reaction.
4 The ribosome now moves along the mRNA, reading the next codon. A third tRNA brings another amino acid, and a peptide bond forms between it and the dipeptide. The first tRNA leaves and is able to collect and bring another of its amino acids.
5 The polypeptide chain grows until a stop codon is reached. There are no corresponding tRNAs for these three codons, UAA, UAC or UGA, so the polypeptide chain is now complete.

Some proteins have to be activated by a chemical, cyclic AMP (cyclic adenosine monophosphate or cAMP) that, like ATP, is a nucleotide derivative. It activates proteins by changing their 3D shape so that their shape is a better fit to their complementary molecules.

Protein synthesis in prokaryotes

In prokaryotes the DNA is not inside a nucleus; translation begins as soon as some mRNA has been made.

Figure 4 Scanning electron micrograph of translation: ribosomes (blue) move along the mRNA strand (pink) assembling proteins (green)

Figure 5 Protein synthesis in the bacterium *Escherichia coli*: DNA (pink) transcription yields mRNA strands (green), which are immediately translated by ribosomes (blue)

Figure 3 Translation of a length of mRNA at a ribosome and assembly of a polypeptide

STRETCH and CHALLENGE

Glycogen in muscle cells can be broken down by an enzyme, glycogen phosphorylase. Glycogen can be synthesised by the enzyme, glycogen synthase. If both were to be happening at the same time, it would waste the cell's energy, so there has to be a control mechanism to 'make or break' glycogen according to the cell's needs.

Glycogen phosphorylase is activated by cAMP but inhibited by ATP and by glucose 6-P. cAMP binds to an allosteric site (not the active site) of the enzyme and causes it to change its shape and bring its previously hidden active site to a more exposed position. If ATP or G-6-P bind, then the shape changes back and the active site becomes buried into the molecule.

Questions

A What do you think the effect of cAMP is on the activity of the enzyme glycogen synthase and how do you think the effect is brought about?
B What do you think the effect of G-6-P is on the activity of glycogen synthase?

Examiner tip

Remember that transcription is copying and then you will remember which stage is which in protein synthesis. Transcription is copying the DNA code onto a piece of mRNA. At ribosomes this code is translated into a protein.

Questions

1 In which type of cell, prokaryote or eukaryote, would you expect protein synthesis to be faster? Give reasons for your answer.
2 What is the minimum number of different tRNA molecules that are needed for protein synthesis?

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Every spread has questions to enable students to check their knowledge and understanding. These are complemented by practice examination questions at the end of every module.

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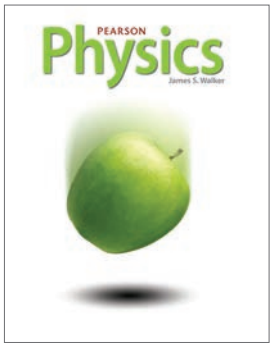

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Student Book

Chapter 8

Lifestyle and health

The issues

Science and technology have done much to make our lives less risky. People in industrialised countries live, on average, longer and healthier lives than in the past. It is now known how to prevent or cure many of the infectious diseases which used to kill large numbers of people. As a result, the main threats to health today in countries like the UK are chronic diseases such as cancer, cardiovascular diseases and type 2 diabetes. Many factors can contribute to the development of these diseases, including the genetic make-up of individuals, their diet, environmental pollutants they encounter, the work they do and the choices they make in how they live.

There is plenty of advice from many sources telling people how to live their lives in ways which will help them to reduce the risks to their health. Often the link between cause and effect is uncertain or remote. Sometimes the advice is contradictory.

The science behind the issues

Cancer is a multifactorial disease. Scientists have identified genes which give people a predisposition to certain cancers, but the health risk can also be increased or decreased by exposure to certain environmental factors, including lifestyle. Large-scale studies help link genes with diseases, by identifying clustering of diseases within families, geographic areas or particular occupations.

What this tells us about science and society

Many illnesses are influenced by several factors and it is sometimes difficult to show convincingly that a particular factor has an effect. This is especially so when the influence of a factor is small or the disease is rare. For example, many of the associations between diet and disease are small, which means that determining whether the effect is real or not is often very difficult. These weak associations may reflect a real effect or may reflect some kind of subtle bias or measurement error that the researchers were unable to detect and eliminate.

Scientists look for correlations, or relationships, between exposure to specific risk factors and disease occurrence. Any uncertainties may be interpreted by scientists, the media and other stakeholders in quite different ways. Their backgrounds, personalities and interests can influence their interpretations. We need to take this into account when evaluating what they say.

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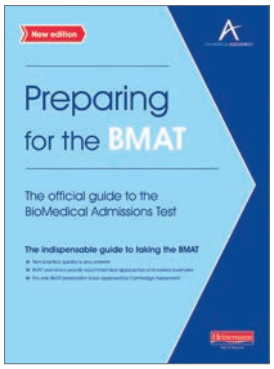

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