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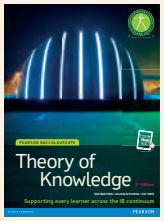

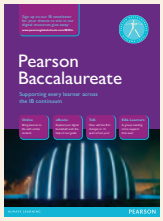

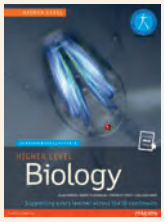

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ToK

We've almost completed our new edition of ToK for the 2013 curriculum change.

Group 4 Sciences

The Group 4 Sciences curriculum change is also keeping us busy, but we are lucky enough to be working with expert authors on updating our extensive suite of resources.

Read more…

Some of our authors have taken time out from writing manuscripts to provide an overview of just some of the changes happening in the IB. Read more about curriculum changes, EAL support and online, digital learning in the classroom in our latest IB magazine, available to download online at: **www.PearsonSchool.com/IBprograms**

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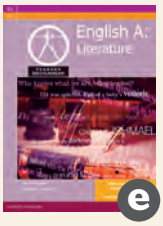

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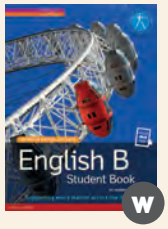

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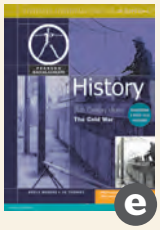

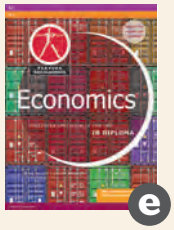

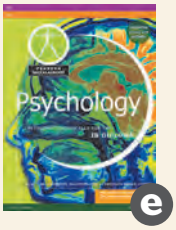

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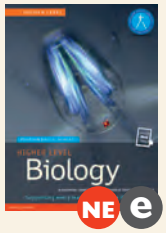

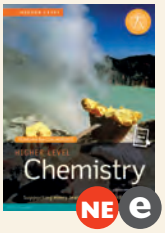

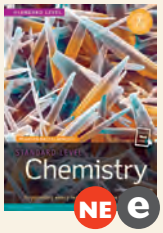

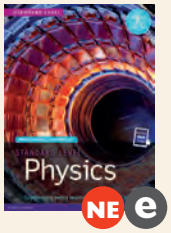

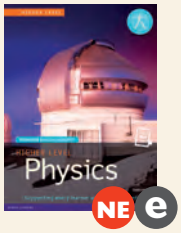

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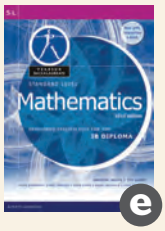

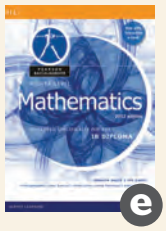

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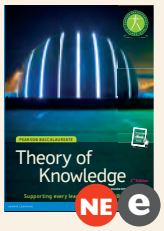

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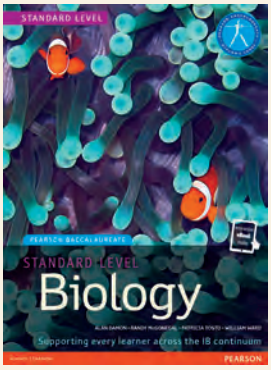

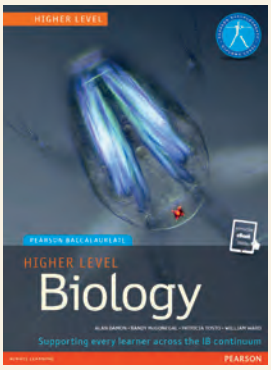

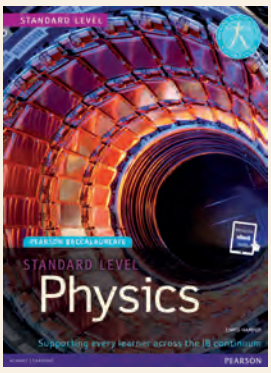

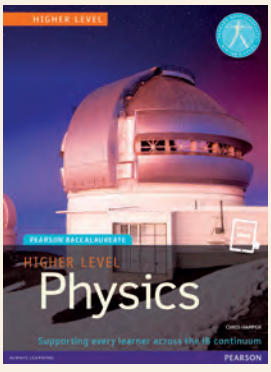

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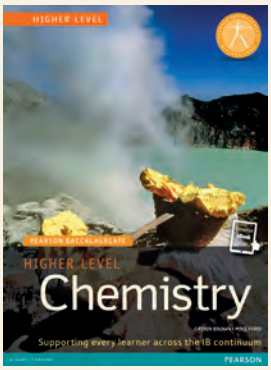

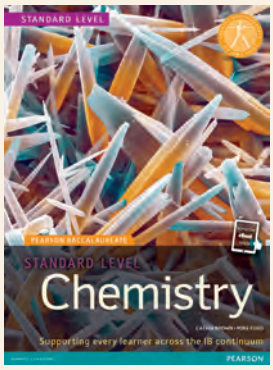

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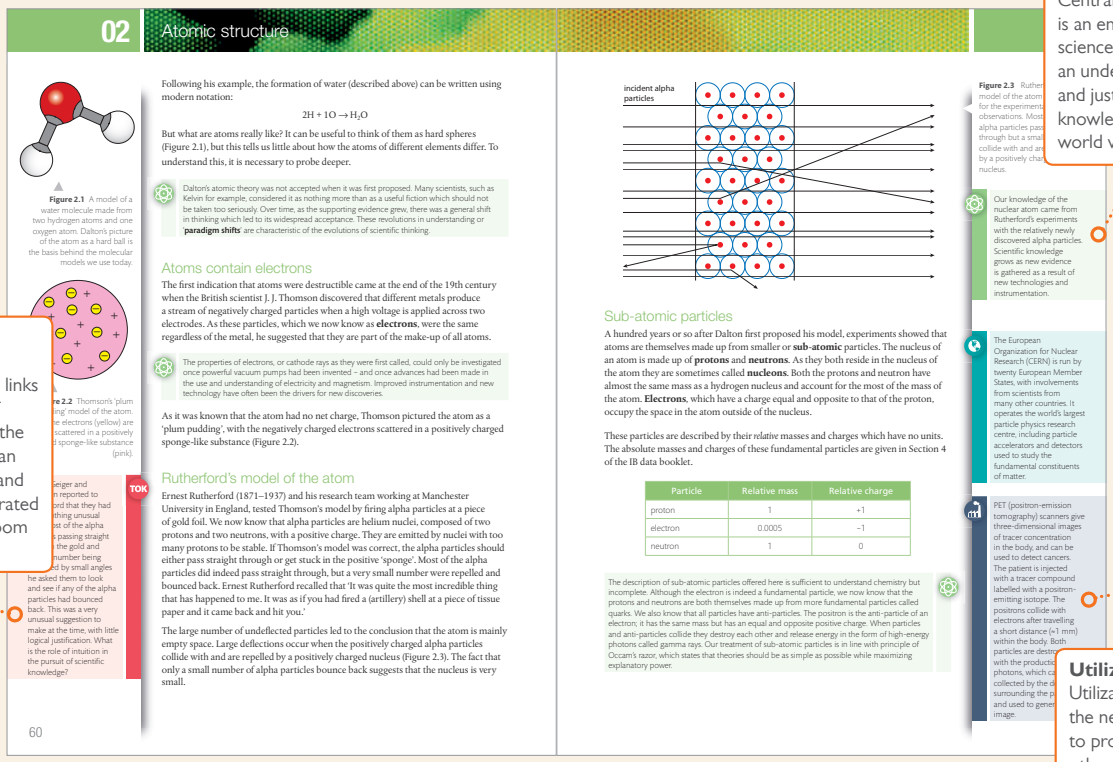
Updated for the 2014 Group 4 curriculum review

Nature of science
Central to the new curriculum is an emphasis on the nature of science. Margin boxes promote an understanding of the proof and justification of scientific knowledge and the scientific world view.

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


02 Atomic structure

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.

incident alpha particles

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.

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.

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 destroy with the products photons, which ca collected by the d surrounding the p and used to gener image.

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Sample pages from **Higher Level Chemistry**

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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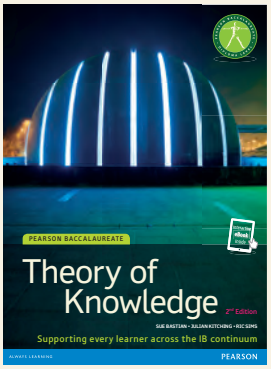

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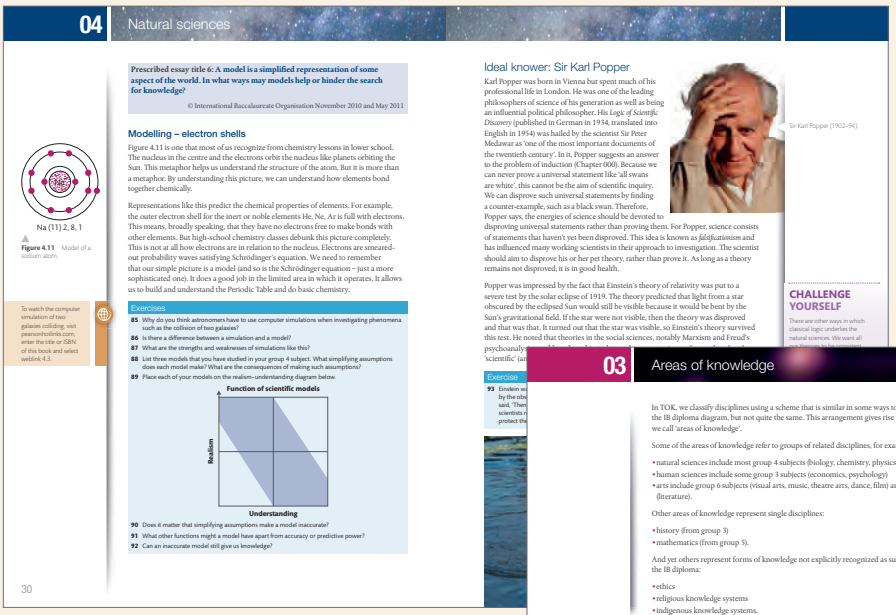

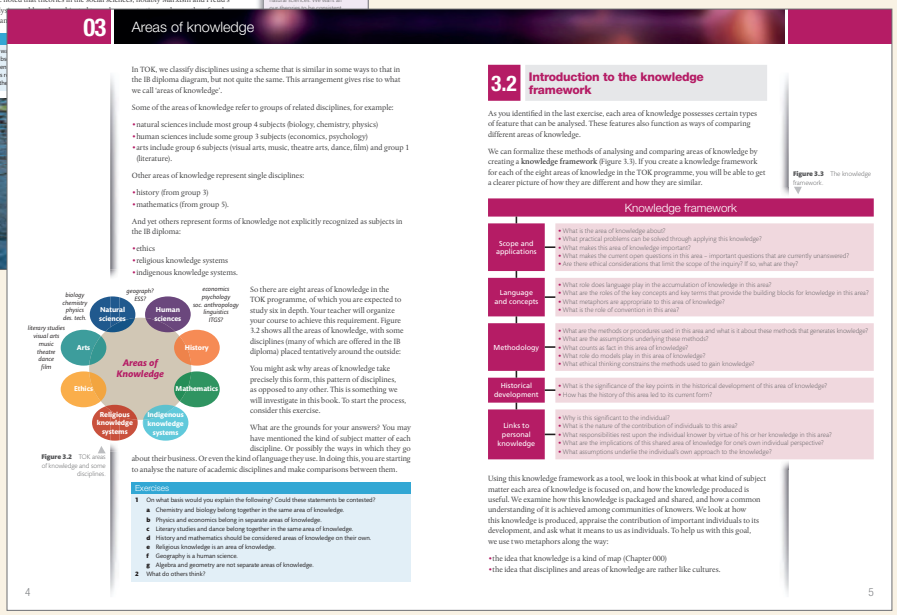

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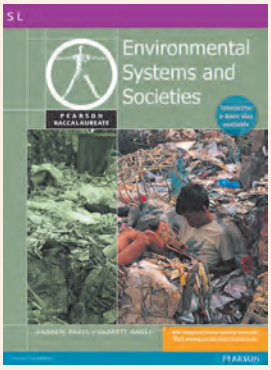

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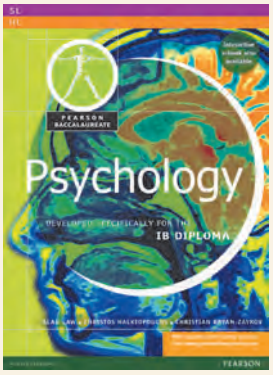

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