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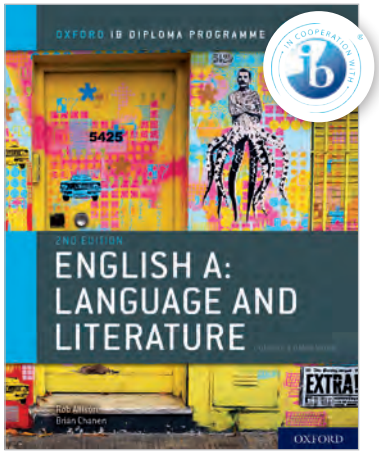

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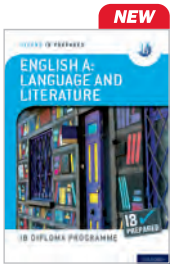

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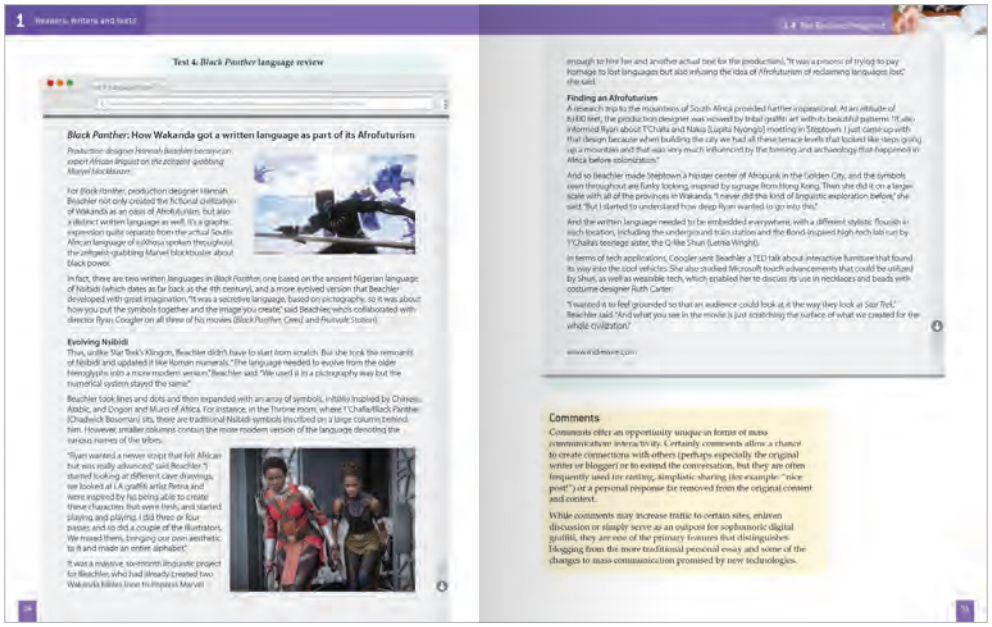

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Krista Stubbs, IB English Teacher, USA

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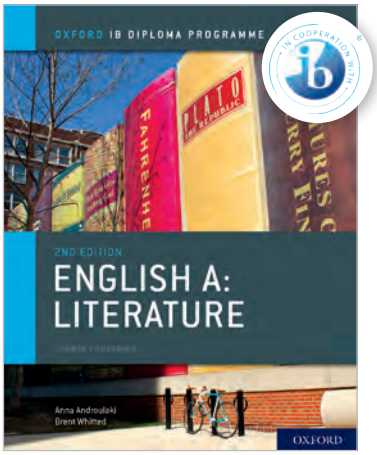

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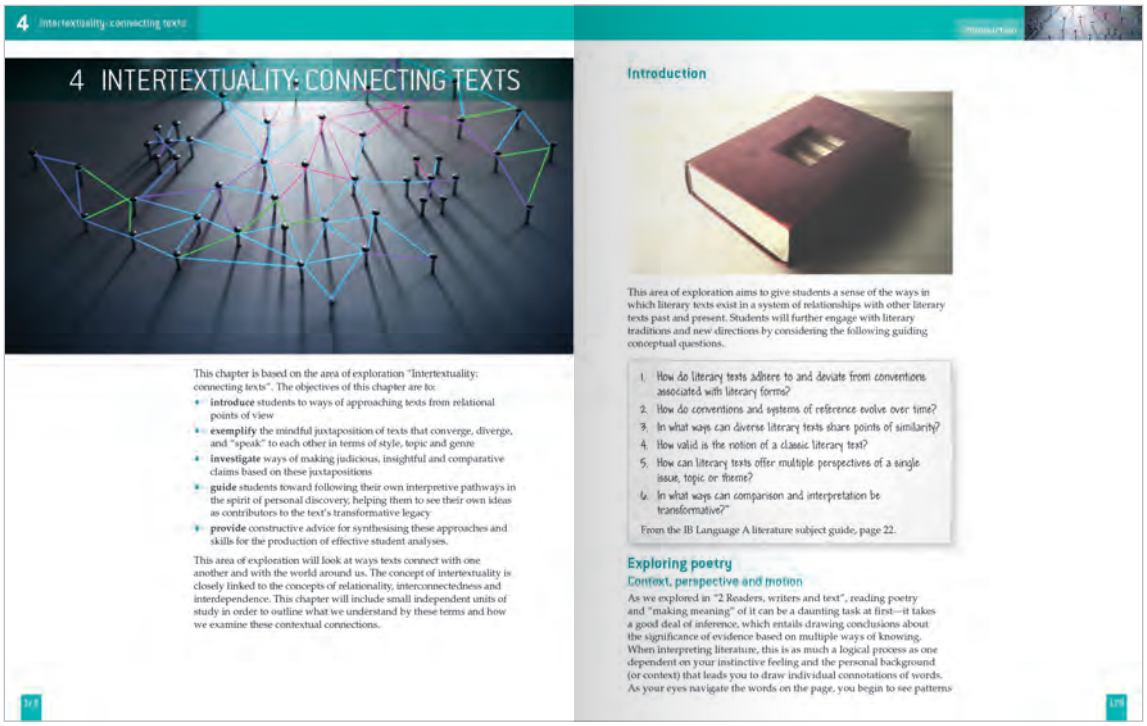

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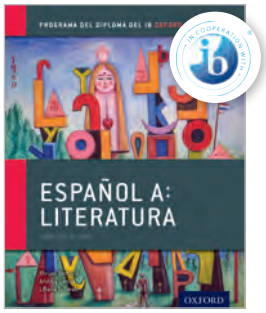

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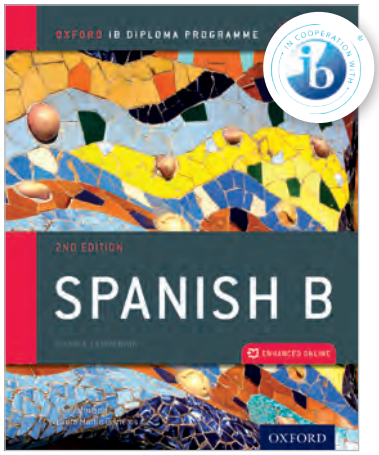

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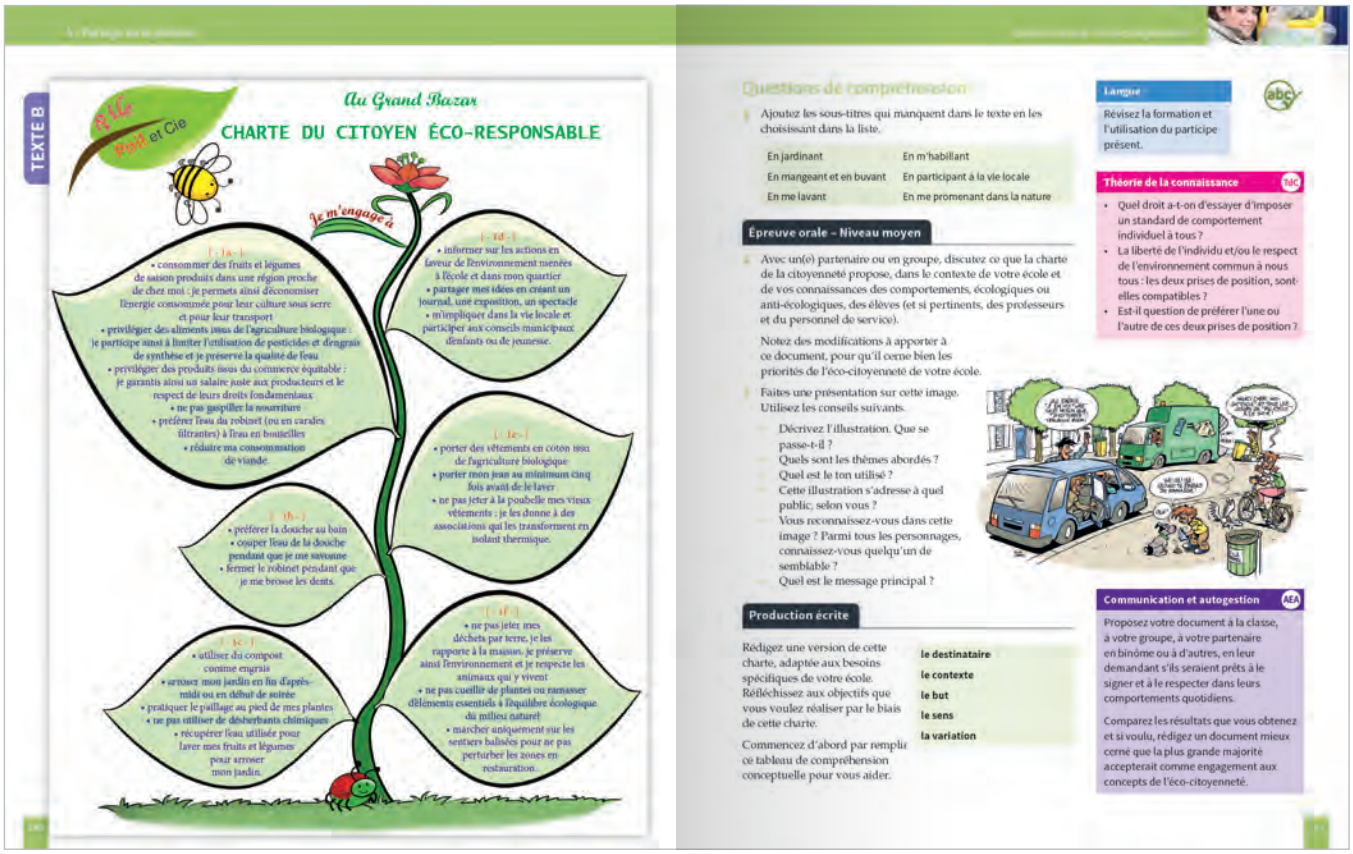

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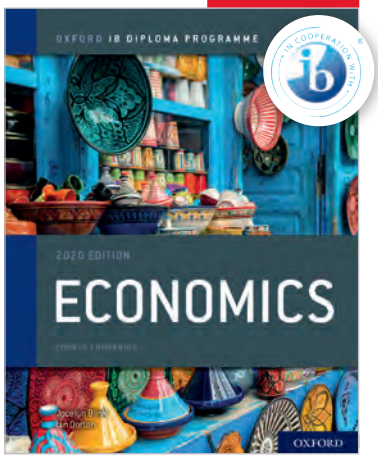

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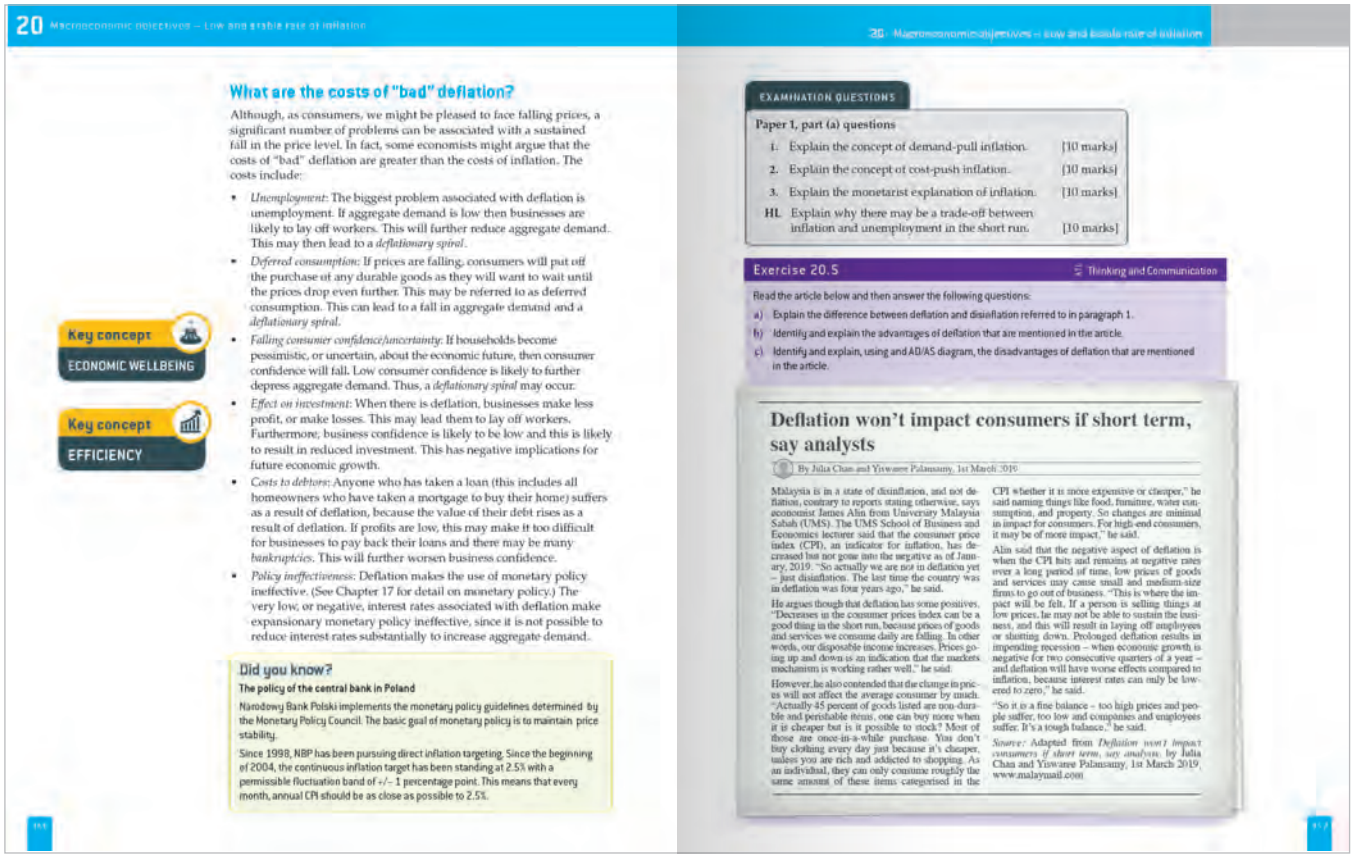

20 Macroeconomic objectives – Low and stable rate of inflation

What are the costs of "bad" deflation?

Although, as consumers, we might be pleased to face falling prices, a significant number of problems can be associated with a sustained fall in the price level. In fact, some economists might argue that the costs of "bad" deflation are greater than the costs of inflation. The costs include:

- *Unemployment*: The biggest problem associated with deflation is unemployment. If aggregate demand is low then businesses are likely to lay off workers. This will further reduce aggregate demand. This may then lead to a *deflationary spiral*.
- *Deferred consumption*: If prices are falling, consumers will put off the purchase of any durable goods as they will want to wait until the prices drop even further. This may be referred to as deferred consumption. This can lead to a fall in aggregate demand and a *deflationary spiral*.
- *Falling consumer confidence/uncertainty*: If households become pessimistic, or uncertain, about the economic future, then consumer confidence will fall. Low consumer confidence is likely to further depress aggregate demand. Thus, a *deflationary spiral* may occur.
- *Effect on investment*: When there is deflation, businesses make less profit, or make losses. This may lead them to lay off workers. Furthermore, business confidence is likely to be low and this is likely to result in reduced investment. This has negative implications for future economic growth.
- *Costs to debtors*: Anyone who has taken a loan (this includes all homeowners who have taken a mortgage to buy their home) suffers as a result of deflation, because the value of their debt rises as a result of deflation. If profits are low, this may make it too difficult for businesses to pay back their loans and there may be many *bankruptcies*. This will further worsen business confidence.
- *Policy ineffectiveness*: Deflation makes the use of monetary policy ineffective. (See Chapter 17 for detail on monetary policy.) The very low, or negative, interest rates associated with deflation make expansionary monetary policy ineffective, since it is not possible to reduce interest rates substantially to increase aggregate demand.

Key concept ECONOMIC WELLBEING

Key concept EFFICIENCY

Did you know?

The policy of the central bank in Poland

Narodowy Bank Polski implements the monetary policy guidelines determined by the Monetary Policy Council. The basic goal of monetary policy is to maintain price stability.

Since 1998, NBP has been pursuing direct inflation targeting. Since the beginning of 2004, the continuous inflation target has been standing at 2.5% with a permissible fluctuation band of +/– 1 percentage point. This means that every month, annual CPI should be as close as possible to 2.5%.

EXAMINATION QUESTIONS

Paper 1, part (a) questions

1. Explain the concept of demand-pull inflation. [10 marks]
2. Explain the concept of cost-push inflation. [10 marks]
3. Explain the monetarist explanation of inflation. [10 marks]

HL Explain why there may be a trade-off between inflation and unemployment in the short run. [10 marks]

Exercise 20.5 Thinking and Communication

Read the article below and then answer the following questions:

a) Explain the difference between deflation and disinflation referred to in paragraph 1.
b) Identify and explain the advantages of deflation that are mentioned in the article.
c) Identify and explain, using and AD/AS diagram, the disadvantages of deflation that are mentioned in the article.

Deflation won't impact consumers if short term, say analysts

By Julia Chan and Yiswaree Palansamy, 1st March 2019

Malaysia is in a state of disinflation, and not deflation, contrary to reports stating otherwise, says economist James Alin from University Malaysia Sabah (UMS). The UMS School of Business and Economics lecturer said that the consumer price index (CPI), an indicator for inflation, has decreased but not gone into the negative as of January, 2019. "So actually we are not in deflation yet – just disinflation. The last time the country was in deflation was four years ago," he said.

He argues though that deflation has some positives. "Decreases in the consumer prices index can be a good thing in the short run, because prices of goods and services we consume daily are falling. In other words, our disposable income increases. Prices going up and down is an indication that the markets mechanism is working rather well," he said.

However, he also contended that the change in prices will not affect the average consumer by much. "Actually 45 percent of goods listed are non-durable and perishable items, one can buy more when it is cheaper but is it possible to stock? Most of those are once-in-a-while purchase. You don't buy clothing every day just because it's cheaper, unless you are rich and addicted to shopping. As an individual, they can only continue roughly the same amount of these items categorised in the CPI whether it is more expensive or cheaper," he said naming things like food, furniture, water consumption, and property. So changes are minimal in impact for consumers. For high-end consumers, it may be of more impact," he said.

Alin said that the negative aspect of deflation is when the CPI hits and remains at negative rates over a long period of time, low prices of goods and services may cause small and medium-size firms to go out of business. "This is where the impact will be felt. If a person is selling things at low prices, he may not be able to sustain the business, and this will result in laying off employees or shutting down. Prolonged deflation results in impending recession – when economic growth is negative for two consecutive quarters of a year – and deflation will have worse effects compared to inflation, because interest rates can only be lowered to zero," he said.

"So it is a fine balance – too high prices and people suffer, too low and companies and employees suffer. It's a tough balance," he said.

Source: Adapted from *Deflation won't impact consumers if short term, say analysts*, by Julia Chan and Yiswaree Palansamy, 1st March 2019, www.malaymail.com

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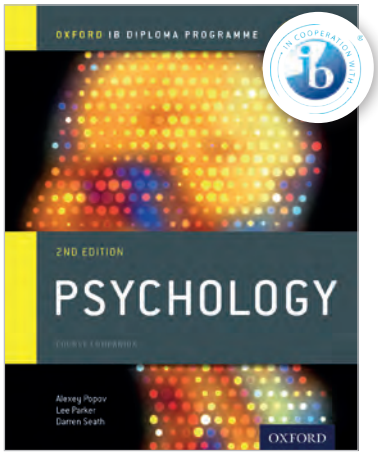

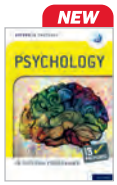

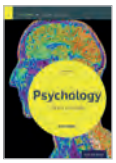

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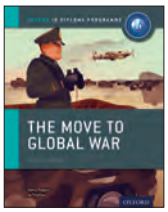

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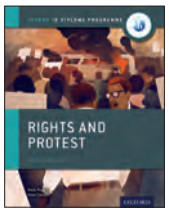

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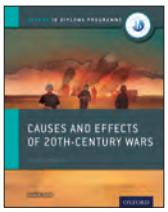

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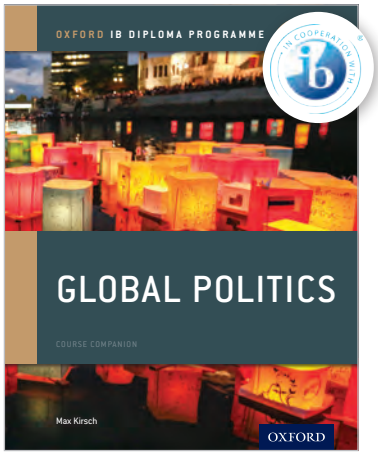

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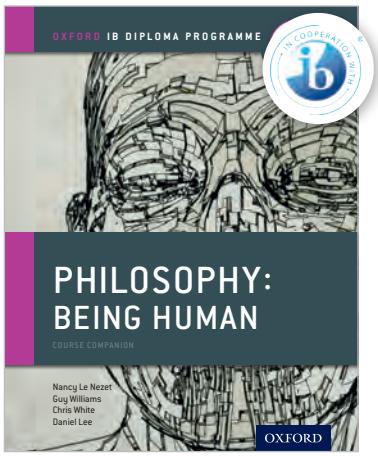

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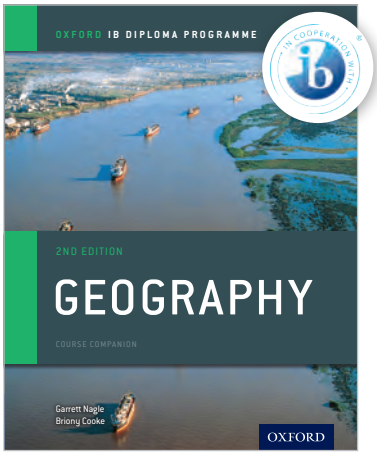

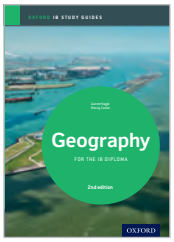

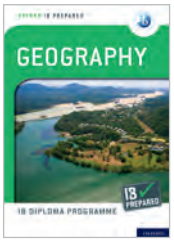

Case study

Urban deindustrialization: decline in Detroit

Detroit was once the USA's fourth-largest city. Indeed, in 1960 it had the highest per-capita income in the USA. Now up to a quarter of the city has been reclaimed by nature. Up to 40,000 buildings and parcels of land are vacant. Property prices have fallen by 80 per cent or more. In 2013 a three-bedroomed house on Albany Street was for sale for $1!

Detroit is the largest US city to declare bankruptcy. Its long-term debts are estimated at over $18 billion, or $27,000 for every resident.

Between 1900 and 1950 Detroit prospered because General Motors (GM), Ford and Chrysler, which made most of the cars sold in the USA, were based there. Detroit's population increased from about 300,000 in 1900 to 1.8 million in 1950, but fell to just 700,000 in 2013.

Many of Detroit's people are poor and relatively poorly educated – over 80 per cent have no more than a high school diploma. Delivering services to sparsely populated neighbourhoods in the city, which sprawls over 340 km², would be difficult even if the city could afford it.

The causes of Detroit's troubles include:

- falling car sales and therefore less tax revenue from the city's large firms
- a shrinking population – many of the richer people have moved away
- high pension and social welfare costs – the city has an ageing population.

Detroit has paid the price for being over-reliant on a single industry – the motor car. It attracted many black workers from the American south to work in the factories. However, inequalities in working conditions and living conditions led to race riots in 1943 and 1967. Many white people abandoned the city during the "white flight" of the 1950s, 1960s and 1970s.

Only 30 per cent of the jobs available in the city are taken by Detroit residents and over 60 per cent of Detroit's population who work do so outside the city. Unemployment had reached 30 per cent by 2013. Over a third of Detroit's population and nearly half its children live below the poverty line. Nearly half of Detroit's adults are functionally illiterate and 29 of the city's schools closed down in 2009 alone. Detroit's population is now 81.6 per cent Afro-American.

According to a report in *The Economist*, law and order has completely broken down in the inner city, and drugs and prostitution are commonplace. Detroit's murder rate is at a 40-year high. Of the city's 85,000 street lights, half are usually out of service because thieves have stripped them for copper. Only one-third of its ambulances are in working order.

However, there is some growth. Urban farms are appearing. Young people – especially artists and musicians – are moving into Detroit to make use of the abandoned and affordable urban spaces. Low rents, good universities and tax breaks are attempting to attract businesses back to the city.

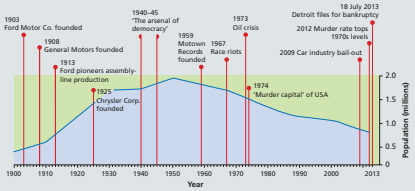

Figure G.19: Population change in Detroit (millions)

Figure G.20: Manufacturing employment in Detroit, 1990–2010

Photo G.13: Decaying vacant buildings in Detroit, 2011

Activity 9

1. Suggest reasons for Detroit's growth between 1900 and 1950.
2. Suggest why Detroit's population declined after 1950.
3. Suggest the likely impacts of a falling population size.
4. Describe the trend in manufacturing employment in Detroit between 1990 and 2010. Suggest the likely impacts of the changes that you have described.
5. Watch "Death of Detroit" at http://www.youtube.com/watch?v=-aUUuTBVypk and "Grown in Detroit" at http://www.youtube.com/watch?v=XH6sI7BqXLo and the "Grown in Detroit" documentary trailer, http://documentaryheaven.com/requiem-for-detroit/.

Concepts in context

Many **processes** operate in urban areas. Some are causing urban areas to increase, such as rural-to-urban migration and natural increase, leading to urbanization. Some are causing urban areas to decline, such as counter-urbanization. Urban areas may therefore grow over time, and develop complex networks of transport, water, sanitation, energy provision, and telecommunications. However, some urban areas decline. This may be due to the decline in industry. However, some former run-down areas may appear attractive to certain populations, and may regenerate as a result of gentrification.

Check your understanding

1. Explain how centrifugal movement of population affects a city and its hinterland (surrounding area).
2. Explain the advantages and disadvantages of counter-urbanization.
3. Explain the process of deindustrialization.
4. Describe the process of urbanization.
5. Suggest why most of the world's growing megacities are found in LICs.
6. Outline the potential impacts of megacities.
7. Describe the growth in telecommunications in Shanghai.
8. Briefly outline the problems associated with the growth of Shanghai.
9. Suggest reasons for the growth of Detroit.
10. Explain the causes and consequences of the decline of population in Detroit.

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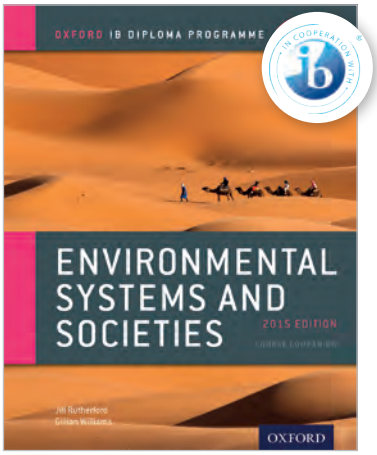

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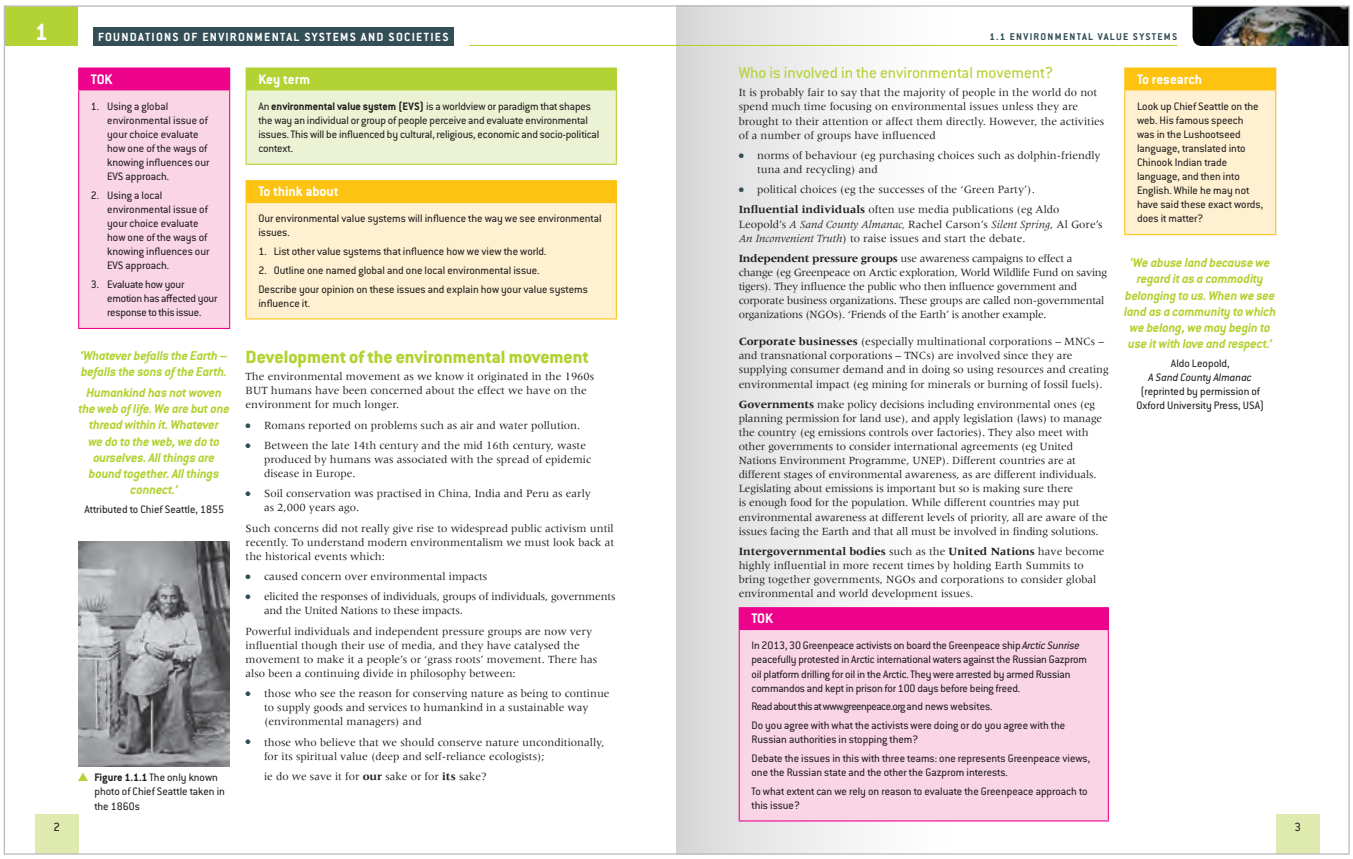

1 FOUNDATIONS OF ENVIRONMENTAL SYSTEMS AND SOCIETIES

TOK

1. Using a global environmental issue of your choice evaluate how one of the ways of knowing influences our EVS approach.
2. Using a local environmental issue of your choice evaluate how one of the ways of knowing influences our EVS approach.
3. Evaluate how your emotion has affected your response to this issue.

Key term

An **environmental value system (EVS)** is a worldview or paradigm that shapes the way an individual or group of people perceive and evaluate environmental issues. This will be influenced by cultural, religious, economic and socio-political context.

To think about

Our environmental value systems will influence the way we see environmental issues.

1. List other value systems that influence how we view the world.
2. Outline one named global and one local environmental issue.

Describe your opinion on these issues and explain how your value systems influence it.

'Whatever befalls the Earth – befalls the sons of the Earth. Humankind has not woven the web of life. We are but one thread within it. Whatever we do to the web, we do to ourselves. All things are bound together. All things connect.'

Attributed to Chief Seattle, 1855

▲ **Figure 1.1.1** The only known photo of Chief Seattle taken in the 1860s

Development of the environmental movement

The environmental movement as we know it originated in the 1960s BUT humans have been concerned about the effect we have on the environment for much longer.

- Romans reported on problems such as air and water pollution.
- Between the late 14th century and the mid 16th century, waste produced by humans was associated with the spread of epidemic disease in Europe.
- Soil conservation was practised in China, India and Peru as early as 2,000 years ago.

Such concerns did not really give rise to widespread public activism until recently. To understand modern environmentalism we must look back at the historical events which:

- caused concern over environmental impacts
- elicited the responses of individuals, groups of individuals, governments and the United Nations to these impacts.

Powerful individuals and independent pressure groups are now very influential though their use of media, and they have catalysed the movement to make it a people's or 'grass roots' movement. There has also been a continuing divide in philosophy between:

- those who see the reason for conserving nature as being to continue to supply goods and services to humankind in a sustainable way (environmental managers) and
- those who believe that we should conserve nature unconditionally, for its spiritual value (deep and self-reliance ecologists);

ie do we save it for **our** sake or for **its** sake?

2

1.1 ENVIRONMENTAL VALUE SYSTEMS

Who is involved in the environmental movement?

It is probably fair to say that the majority of people in the world do not spend much time focusing on environmental issues unless they are brought to their attention or affect them directly. However, the activities of a number of groups have influenced

- norms of behaviour (eg purchasing choices such as dolphin-friendly tuna and recycling) and
- political choices (eg the successes of the 'Green Party').

Influential individuals often use media publications (eg Aldo Leopold's *A Sand County Almanac*, Rachel Carson's *Silent Spring*, Al Gore's *An Inconvenient Truth*) to raise issues and start the debate.

Independent pressure groups use awareness campaigns to effect a change (eg Greenpeace on Arctic exploration, World Wildlife Fund on saving tigers). They influence the public who then influence government and corporate business organizations. These groups are called non-governmental organizations (NGOs). 'Friends of the Earth' is another example.

Corporate businesses (especially multinational corporations – MNCs – and transnational corporations – TNCs) are involved since they are supplying consumer demand and in doing so using resources and creating environmental impact (eg mining for minerals or burning of fossil fuels).

Governments make policy decisions including environmental ones (eg planning permission for land use), and apply legislation (laws) to manage the country (eg emissions controls over factories). They also meet with other governments to consider international agreements (eg United Nations Environment Programme, UNEP). Different countries are at different stages of environmental awareness, as are different individuals. Legislating about emissions is important but so is making sure there is enough food for the population. While different countries may put environmental awareness at different levels of priority, all are aware of the issues facing the Earth and that all must be involved in finding solutions.

Intergovernmental bodies such as the **United Nations** have become highly influential in more recent times by holding Earth Summits to bring together governments, NGOs and corporations to consider global environmental and world development issues.

TOK

In 2013, 30 Greenpeace activists on board the Greenpeace ship *Arctic Sunrise* peacefully protested in Arctic international waters against the Russian Gazprom oil platform drilling for oil in the Arctic. They were arrested by armed Russian commandos and kept in prison for 100 days before being freed.

Read about this at www.greenpeace.org and news websites.

Do you agree with what the activists were doing or do you agree with the Russian authorities in stopping them?

Debate the issues in this with three teams: one represents Greenpeace views, one the Russian state and the other the Gazprom interests.

To what extent can we rely on reason to evaluate the Greenpeace approach to this issue?

To research

Look up Chief Seattle on the web. His famous speech was in the Lushootseed language, translated into Chinook Indian trade language, and then into English. While he may not have said these exact words, does it matter?

'We abuse land because we regard it as a commodity belonging to us. When we see land as a community to which we belong, we may begin to use it with love and respect.'

Aldo Leopold,
A Sand County Almanac
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3

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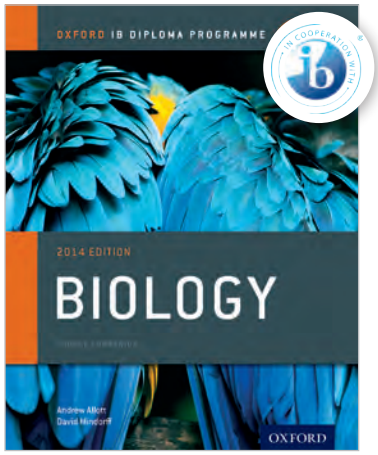

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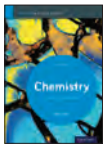
Study Guides	 978 019 839351 1 £28.99	 978 019 839353 5 £28.99	 978 019 839355 9 £28.99
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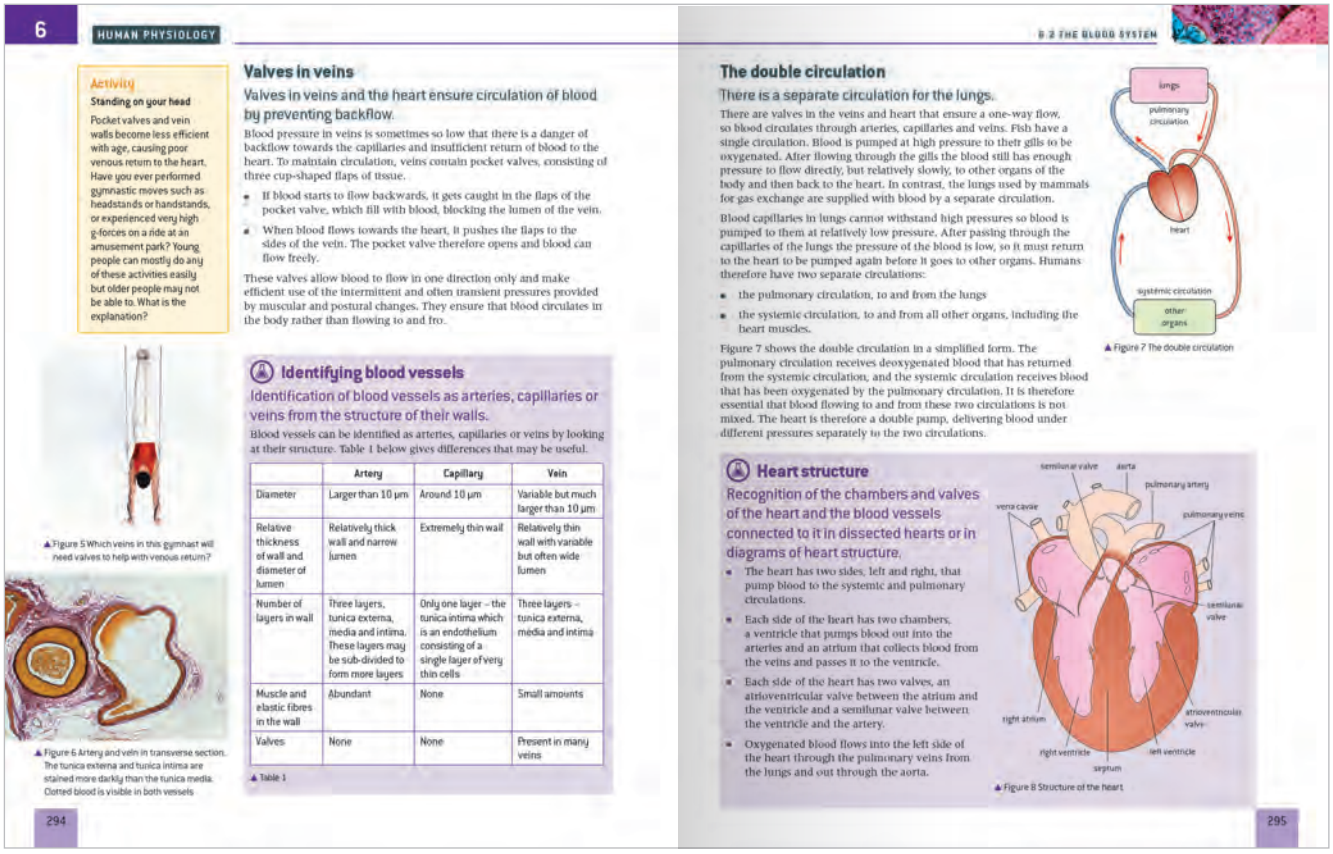

6 HUMAN PHYSIOLOGY

Activity

Standing on your head

Pocket valves and vein walls become less efficient with age, causing poor venous return to the heart. Have you ever performed gymnastic moves such as headstands or handstands, or experienced very high g-forces on a ride at an amusement park? Young people can mostly do any of these activities easily but older people may not be able to. What is the explanation?

Valves in veins

Valves in veins and the heart ensure circulation of blood by preventing backflow.

Blood pressure in veins is sometimes so low that there is a danger of backflow towards the capillaries and insufficient return of blood to the heart. To maintain circulation, veins contain pocket valves, consisting of three cup-shaped flaps of tissue.

- If blood starts to flow backwards, it gets caught in the flaps of the pocket valve, which fill with blood, blocking the lumen of the vein.
- When blood flows towards the heart, it pushes the flaps to the sides of the vein. The pocket valve therefore opens and blood can flow freely.

These valves allow blood to flow in one direction only and make efficient use of the intermittent and often transient pressures provided by muscular and postural changes. They ensure that blood circulates in the body rather than flowing to and fro.

▲ Figure 5 Which veins in this gymnast will need valves to help with venous return?

▲ Figure 6 Artery and vein in transverse section. The tunica externa and tunica intima are stained more darkly than the tunica media. Clotted blood is visible in both vessels

Identifying blood vessels

Identification of blood vessels as arteries, capillaries or veins from the structure of their walls.

Blood vessels can be identified as arteries, capillaries or veins by looking at their structure. Table 1 below gives differences that may be useful.

	Artery	Capillary	Vein
Diameter	Larger than 10 μm	Around 10 μm	Variable but much larger than 10 μm
Relative thickness of wall and diameter of lumen	Relatively thick wall and narrow lumen	Extremely thin wall	Relatively thin wall with variable but often wide lumen
Number of layers in wall	Three layers, tunica externa, media and intima. These layers may be sub-divided to form more layers	Only one layer – the tunica intima which is an endothelium consisting of a single layer of very thin cells	Three layers – tunica externa, media and intima
Muscle and elastic fibres in the wall	Abundant	None	Small amounts
Valves	None	None	Present in many veins

▲ Table 1

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6.2 THE BLOOD SYSTEM

The double circulation

There is a separate circulation for the lungs.

There are valves in the veins and heart that ensure a one-way flow, so blood circulates through arteries, capillaries and veins. Fish have a single circulation. Blood is pumped at high pressure to their gills to be oxygenated. After flowing through the gills the blood still has enough pressure to flow directly, but relatively slowly, to other organs of the body and then back to the heart. In contrast, the lungs used by mammals for gas exchange are supplied with blood by a separate circulation.

Blood capillaries in lungs cannot withstand high pressures so blood is pumped to them at relatively low pressure. After passing through the capillaries of the lungs the pressure of the blood is low, so it must return to the heart to be pumped again before it goes to other organs. Humans therefore have two separate circulations:

- the pulmonary circulation, to and from the lungs
- the systemic circulation, to and from all other organs, including the heart muscles.

Figure 7 shows the double circulation in a simplified form. The pulmonary circulation receives deoxygenated blood that has returned from the systemic circulation, and the systemic circulation receives blood that has been oxygenated by the pulmonary circulation. It is therefore essential that blood flowing to and from these two circulations is not mixed. The heart is therefore a double pump, delivering blood under different pressures separately to the two circulations.

▲ Figure 7 The double circulation

Heart structure

Recognition of the chambers and valves of the heart and the blood vessels connected to it in dissected hearts or in diagrams of heart structure.

- The heart has two sides, left and right, that pump blood to the systemic and pulmonary circulations.
- Each side of the heart has two chambers, a ventricle that pumps blood out into the arteries and an atrium that collects blood from the veins and passes it to the ventricle.
- Each side of the heart has two valves, an atrioventricular valve between the atrium and the ventricle and a semilunar valve between the ventricle and the artery.
- Oxygenated blood flows into the left side of the heart through the pulmonary veins from the lungs and out through the aorta.

▲ Figure 8 Structure of the heart

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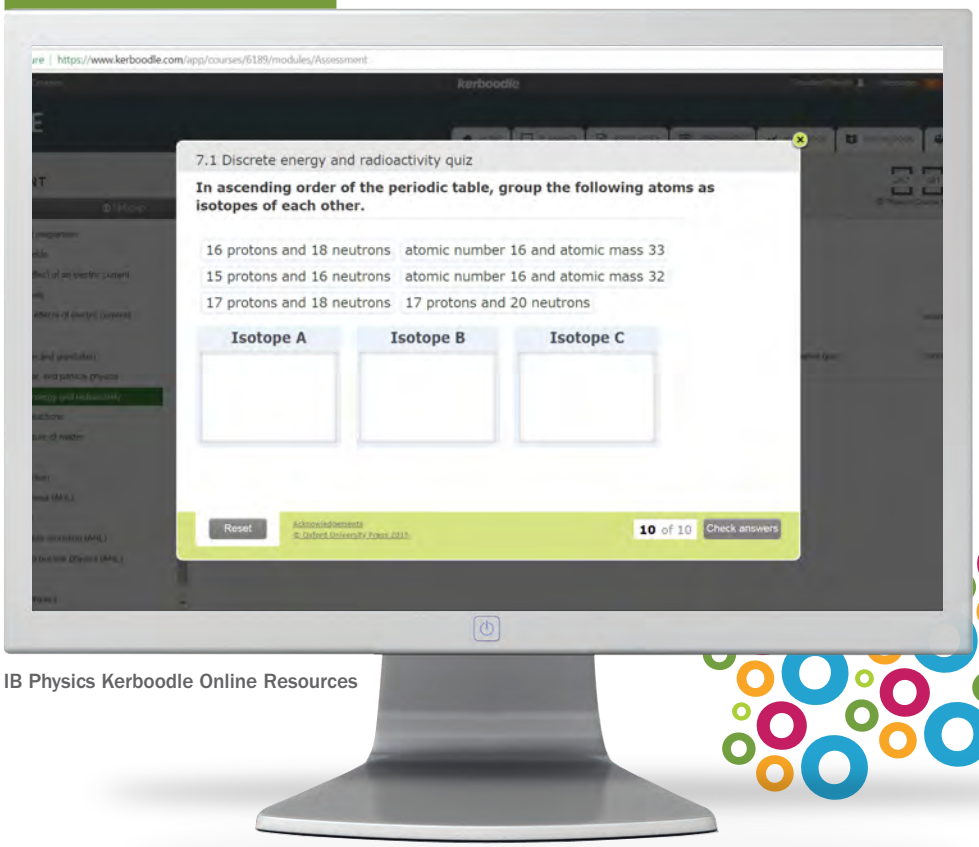

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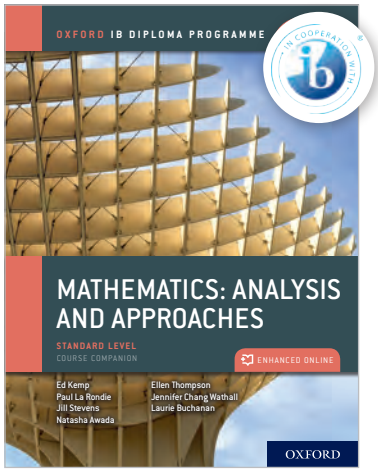

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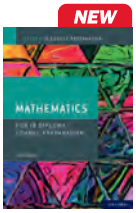

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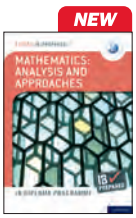

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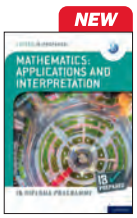

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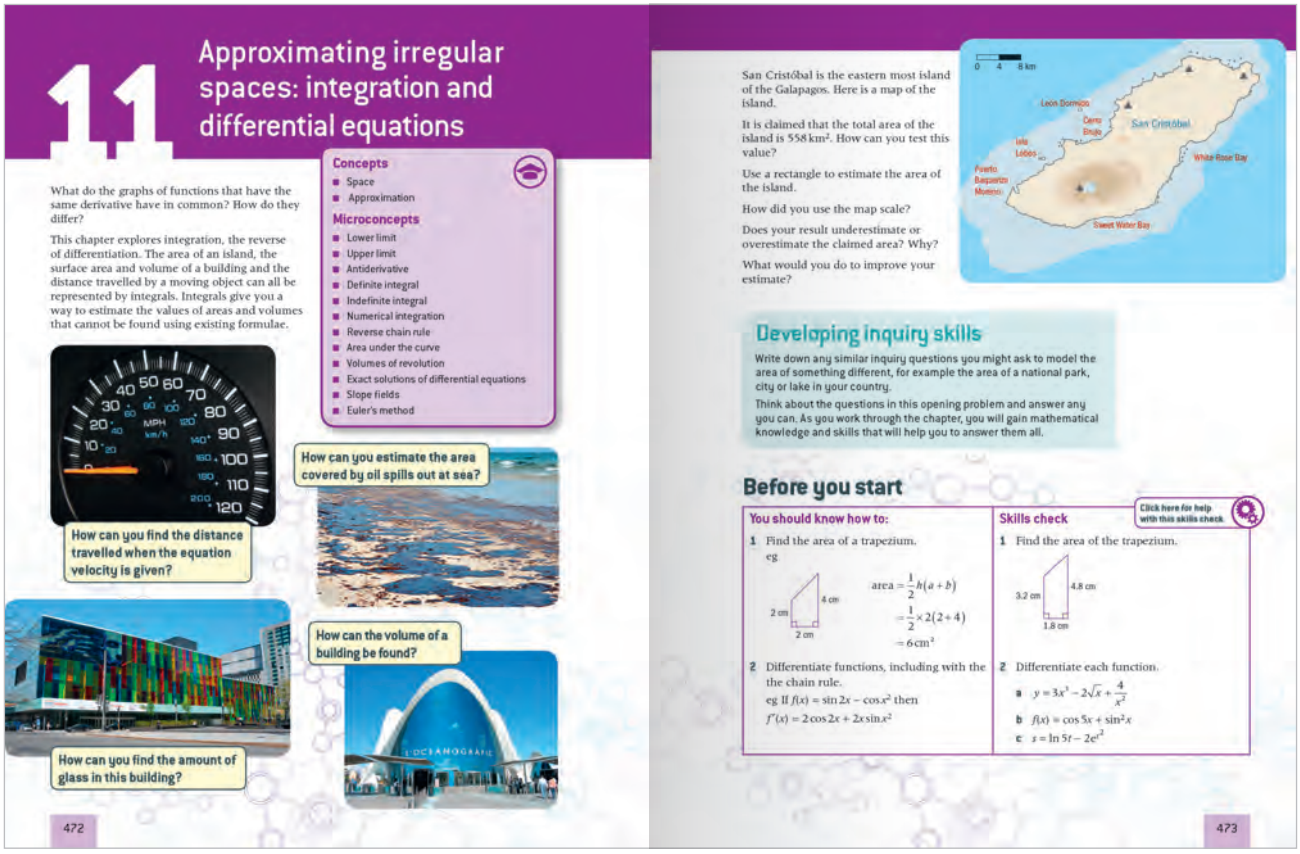

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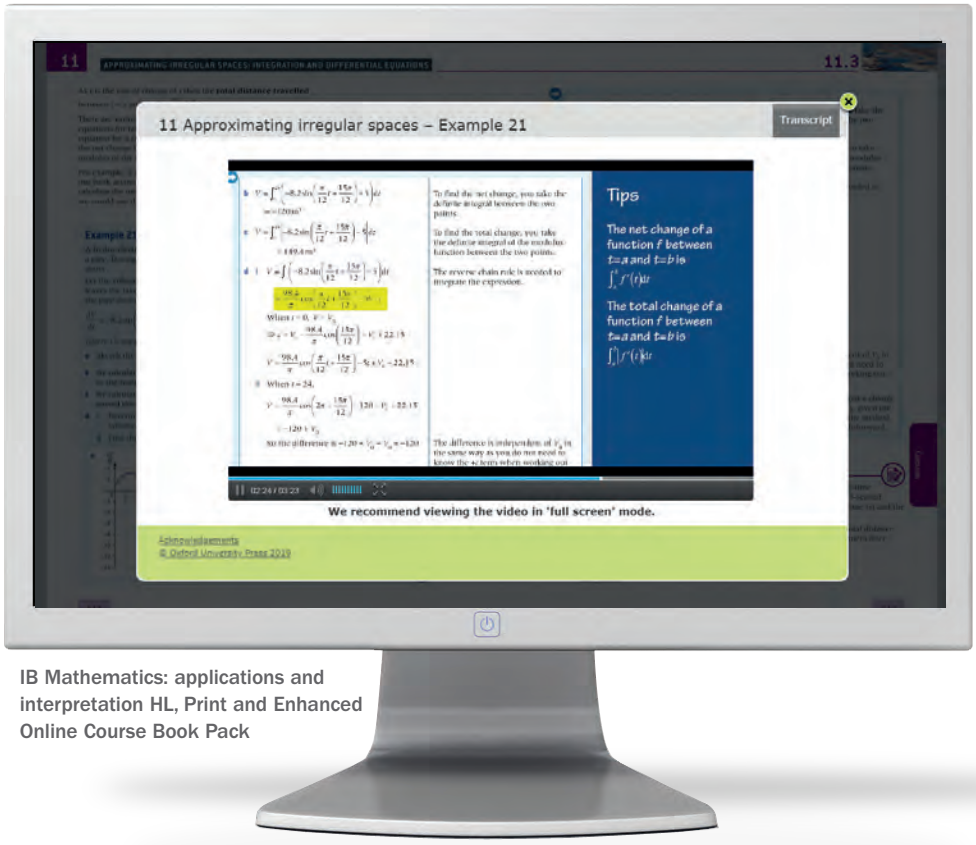

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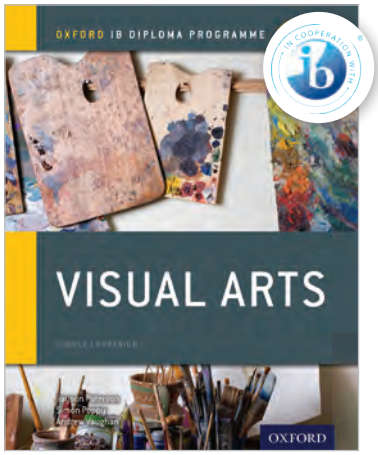

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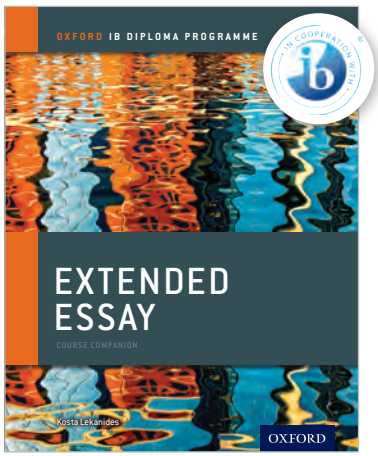

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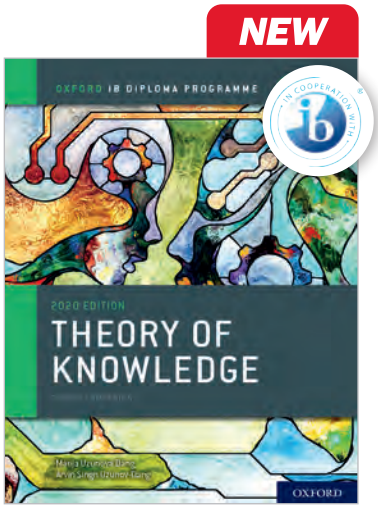

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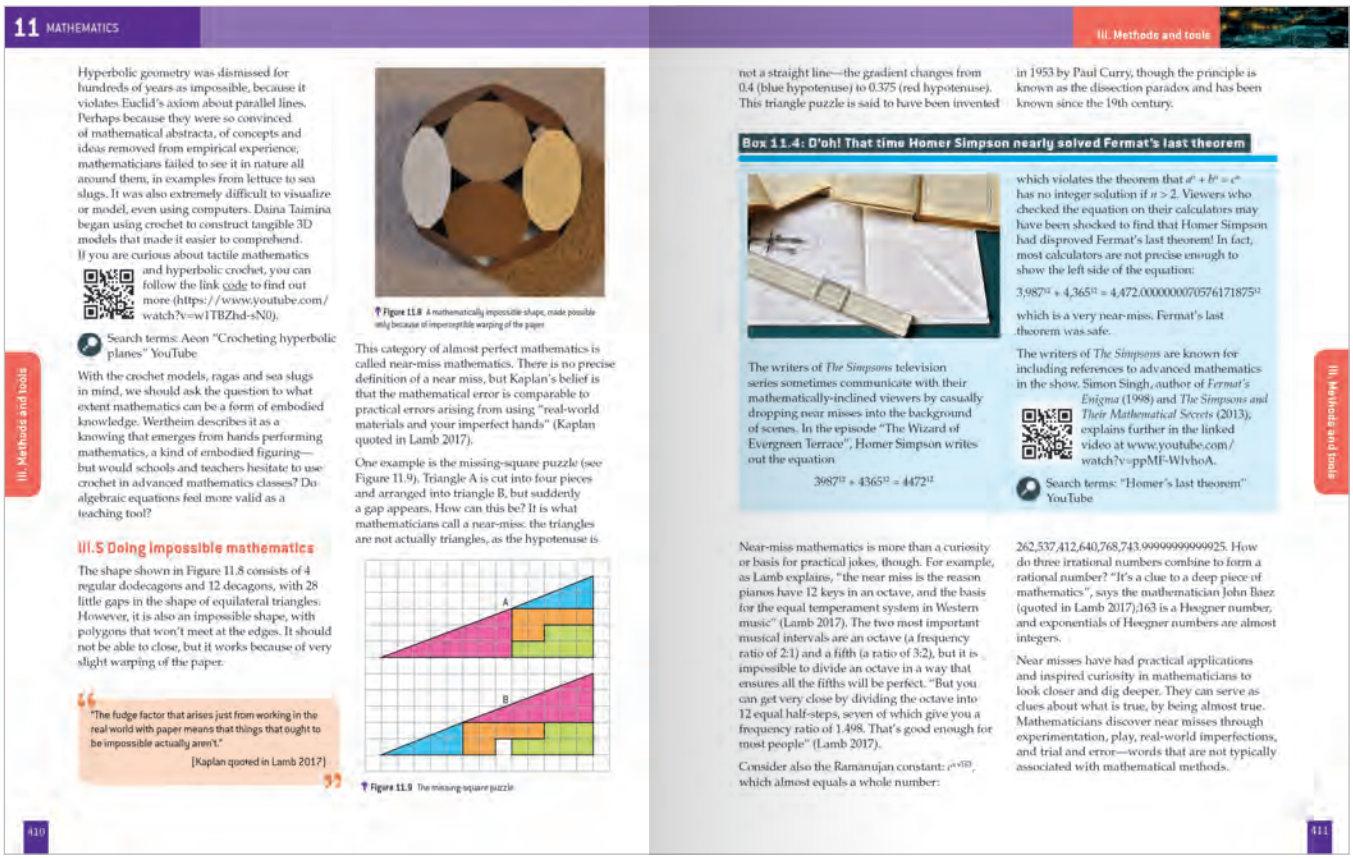
11 MATHEMATICS

iii. Methods and tools

Hyperbolic geometry was dismissed for hundreds of years as impossible, because it violates Euclid's axiom about parallel lines. Perhaps because they were so convinced of mathematical abstracta, of concepts and ideas removed from empirical experience, mathematicians failed to see it in nature all around them, in examples from lettuce to sea slugs. It was also extremely difficult to visualize or model, even using computers. Daina Taimina began using crochet to construct tangible 3D models that made it easier to comprehend. If you are curious about tactile mathematics and hyperbolic crochet, you can follow the link code to find out more (https://www.youtube.com/watch?v=wITBZhd-sN0).

Search terms: Aeon "Crocheting hyperbolic planes" YouTube

With the crochet models, ragas and sea slugs in mind, we should ask the question to what extent mathematics can be a form of embodied knowledge. Wertheim describes it as a knowing that emerges from hands performing mathematics, a kind of embodied figuring—but would schools and teachers hesitate to use crochet in advanced mathematics classes? Do algebraic equations feel more valid as a teaching tool?

iii.5 Doing impossible mathematics

The shape shown in Figure 11.8 consists of 4 regular dodecagons and 12 decagons, with 28 little gaps in the shape of equilateral triangles. However, it is also an impossible shape, with polygons that won't meet at the edges. It should not be able to close, but it works because of very slight warping of the paper.

> "The fudge factor that arises just from working in the real world with paper means that things that ought to be impossible actually aren't."
>
> [Kaplan quoted in Lamb 2017]

Figure 11.8 A mathematically impossible shape, made possible only because of imperceptible warping of the paper

This category of almost perfect mathematics is called near-miss mathematics. There is no precise definition of a near miss, but Kaplan's belief is that the mathematical error is comparable to practical errors arising from using "real-world materials and your imperfect hands" (Kaplan quoted in Lamb 2017).

One example is the missing-square puzzle (see Figure 11.9). Triangle A is cut into four pieces and arranged into triangle B, but suddenly a gap appears. How can this be? It is what mathematicians call a near-miss: the triangles are not actually triangles, as the hypotenuse is not a straight line—the gradient changes from 0.4 (blue hypotenuse) to 0.375 (red hypotenuse). This triangle puzzle is said to have been invented in 1953 by Paul Curry, though the principle is known as the dissection paradox and has been known since the 19th century.

Figure 11.9 The missing-square puzzle

Box 11.4: D'oh! That time Homer Simpson nearly solved Fermat's last theorem

The writers of *The Simpsons* television series sometimes communicate with their mathematically-inclined viewers by casually dropping near misses into the background of scenes. In the episode "The Wizard of Evergreen Terrace", Homer Simpson writes out the equation

$$3987^{12} + 4365^{12} = 4472^{12}$$

which violates the theorem that $a^n + b^n = c^n$ has no integer solution if $n > 2$. Viewers who checked the equation on their calculators may have been shocked to find that Homer Simpson had disproved Fermat's last theorem! In fact, most calculators are not precise enough to show the left side of the equation:

$3,987^{12} + 4,365^{12} = 4,472.000000007057617187 5^{12}$

which is a very near-miss. Fermat's last theorem was safe.

The writers of *The Simpsons* are known for including references to advanced mathematics in the show. Simon Singh, author of *Fermat's Enigma* (1998) and *The Simpsons and Their Mathematical Secrets* (2013), explains further in the linked video at www.youtube.com/watch?v=ppMF-WlvhoA.

Search terms: "Homer's last theorem" YouTube

Near-miss mathematics is more than a curiosity or basis for practical jokes, though. For example, as Lamb explains, "the near miss is the reason pianos have 12 keys in an octave, and the basis for the equal temperament system in Western music" (Lamb 2017). The two most important musical intervals are an octave (a frequency ratio of 2:1) and a fifth (a ratio of 3:2), but it is impossible to divide an octave in a way that ensures all the fifths will be perfect. "But you can get very close by dividing the octave into 12 equal half-steps, seven of which give you a frequency ratio of 1.498. That's good enough for most people" (Lamb 2017).

Consider also the Ramanujan constant: $e^{\pi\sqrt{163}}$, which almost equals a whole number: 262,537,412,640,768,743.99999999999925. How do three irrational numbers combine to form a rational number? "It's a clue to a deep piece of mathematics", says the mathematician John Baez (quoted in Lamb 2017):163 is a Heegner number, and exponentials of Heegner numbers are almost integers.

Near misses have had practical applications and inspired curiosity in mathematicians to look closer and dig deeper. They can serve as clues about what is true, by being almost true. Mathematicians discover near misses through experimentation, play, real-world imperfections, and trial and error—words that are not typically associated with mathematical methods.

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IB Theory of Knowledge Course Book (2020 edition)

Content is subject to change prior to final publication of the TOK Course Book

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DP

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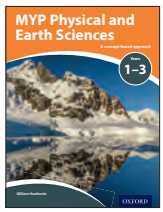

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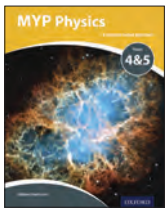

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Deliver engaging, relevant material

THE EARTH

ATL Creativity and innovation skills

Earthquakes in cities

Some cities such as Tokyo and Los Angeles are located near tectonic boundaries. As a result, they experience many earthquakes. Tokyo experiences a detectable earthquake almost every week although the majority of these are weak.

As a result of the frequent earthquakes in Japan, all new buildings have to be designed to withstand strong earthquakes. These innovative buildings have foundations that absorb the energy of the earthquake. They are also built to be flexible so that they are not damaged when they shake.

▲ The Roppongi Hills Mori Tower is one of Tokyo's tallest buildings. The foundations are built with oil-filled shock absorbers that control the swaying of the building in an earthquake

Are other planets like the Earth?

Studying other planets enables us to draw comparisons with the Earth. Scientists want to know whether the same processes that occur on Earth are also happening on other planets—or is the Earth unique?

The planets that are most like Earth are Venus and Mars. Venus is often regarded as Earth's sister planet because it is a similar distance from the Sun and is only a little smaller than the Earth. However, its dense atmosphere creates highly inhospitable conditions on the surface. The temperature at the surface is about 460°C and the pressure is almost 100 times the atmospheric pressure on Earth. The longest time that a probe has managed to operate on the surface is just over two hours, when the *Venera 13* mission landed in 1982. Despite this, scientists have been able to use radar measurements to image the surface of Venus and have found thousands of volcanoes. However, none have been seen to erupt and so it is not known whether Venus is still volcanically active. It is not thought that Venus has any tectonic activity.

Mars, while further from the Earth, is easier to study. It also has volcanoes, the tallest being Olympus Mons, which is nearly 22 km high. It is possible that Mars once had tectonic activity, although this has not happened for many billions of years. While most of the rocks are igneous, sedimentary rocks have also been found. This indicates that Mars may once have had liquid water flowing over its surface.

▲ Maat Mons, the highest volcano on Venus, is 8 km high. It is unknown whether it is active, or whether it has been dormant or even extinct for a long time

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▲ Mars has many extinct volcanoes. Olympus Mons, the largest, is seen to the bottom right of the picture and is almost 22 km high

ABC A **cryovolcano** is a volcano that has eruptions of ice and water. They occur on moons and planets in the solar system.

While Mars and Venus have extinct volcanoes, there are some places in the solar system where active volcanoes have been found. These volcanoes eject water and ice instead of hot rock. They are called **cryovolcanoes**. Cryovolcanoes have been found on some moons of Jupiter, Saturn and Neptune and it is likely that they exist elsewhere in the solar system as well. To fuel these volcanoes, the moons need a source of heat. As the moons orbit these giant planets, the large gravitational forces cause the moon to be flexed and bent as it rotates. The frictional forces that act against the deforming of the moon transfer energy to heat and heat up the inside of the moon. It is thought that the insides of these moons have liquid water in the form of giant underground oceans.

1. Why do astronomers get excited about discovering liquid water on other moons or planets?

How have humans changed the Earth?

It is tempting to see the Earth as being too large to be changed by human activity. After all, the total mass of all humans (about 385 million tonnes) is much less than the huge mass of the Earth (about 6000 million million million tonnes). However, the action of humans is significant, and some scientists have proposed that the Earth has entered a new age—the Anthropocene—whereby human activity is the dominant effect on the world.

▲ This picture, taken by NASA's *Cassini* probe, shows plumes of ice that are ejected from Enceladus, a moon of Saturn

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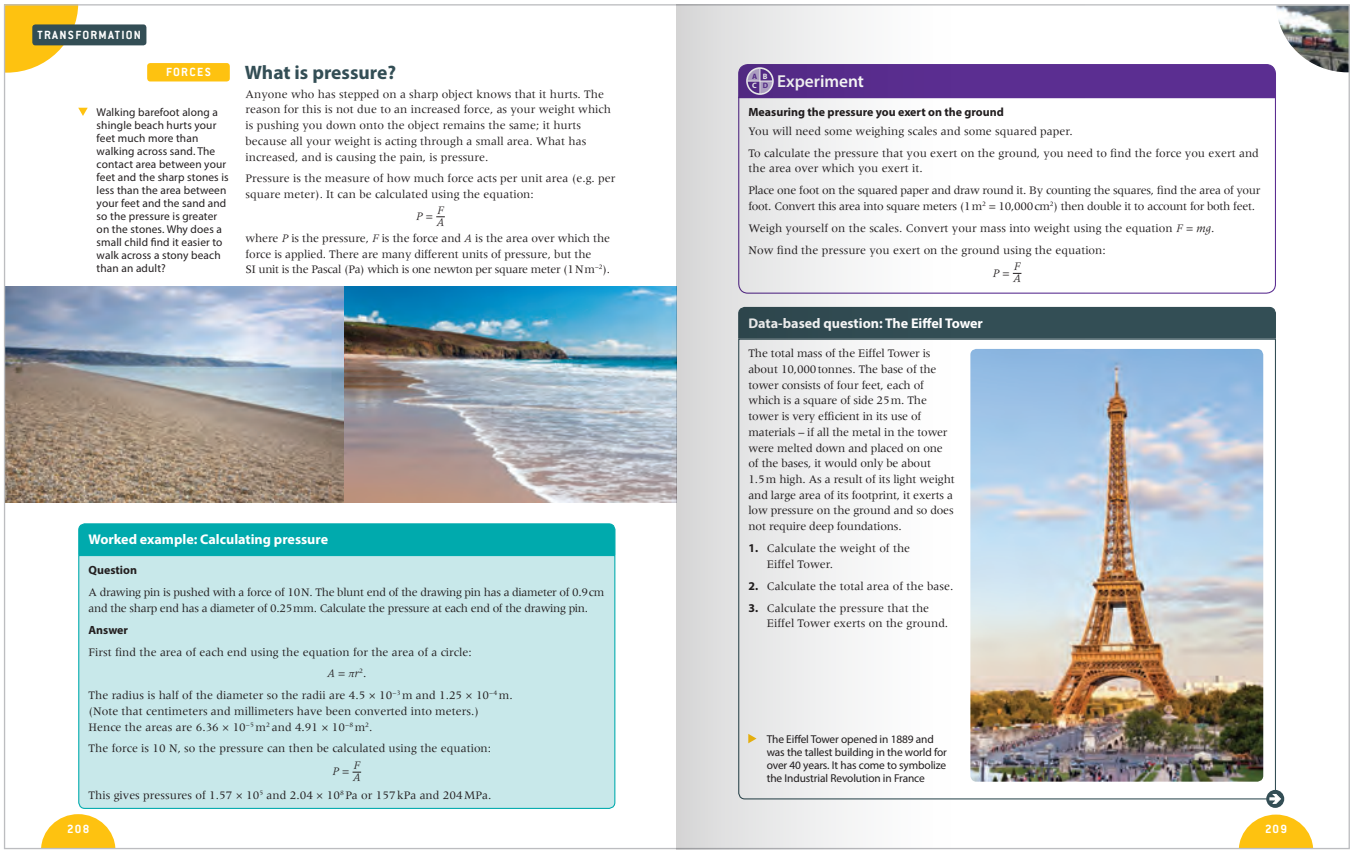
MYP

Sciences

MYP Physical and Earth Sciences 1-3 Student Book

Integrate concepts into learning



TRANSFORMATION

FORCES

What is pressure?

▼ Walking barefoot along a shingle beach hurts your feet much more than walking across sand. The contact area between your feet and the sharp stones is less than the area between your feet and the sand and so the pressure is greater on the stones. Why does a small child find it easier to walk across a stony beach than an adult?

Anyone who has stepped on a sharp object knows that it hurts. The reason for this is not due to an increased force, as your weight which is pushing you down onto the object remains the same; it hurts because all your weight is acting through a small area. What has increased, and is causing the pain, is pressure.

Pressure is the measure of how much force acts per unit area (e.g. per square meter). It can be calculated using the equation:

$$P = \frac{F}{A}$$

where P is the pressure, F is the force and A is the area over which the force is applied. There are many different units of pressure, but the SI unit is the Pascal (Pa) which is one newton per square meter ($1\,Nm^{-2}$).

Worked example: Calculating pressure

Question

A drawing pin is pushed with a force of 10N. The blunt end of the drawing pin has a diameter of 0.9cm and the sharp end has a diameter of 0.25mm. Calculate the pressure at each end of the drawing pin.

Answer

First find the area of each end using the equation for the area of a circle:

$$A = \pi r^2.$$

The radius is half of the diameter so the radii are 4.5×10^{-3}m and 1.25×10^{-4}m. (Note that centimeters and millimeters have been converted into meters.) Hence the areas are $6.36 \times 10^{-5}\,m^2$ and $4.91 \times 10^{-8}\,m^2$.

The force is 10 N, so the pressure can then be calculated using the equation:

$$P = \frac{F}{A}$$

This gives pressures of 1.57×10^5 and 2.04×10^8 Pa or 157kPa and 204MPa.

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Experiment

Measuring the pressure you exert on the ground

You will need some weighing scales and some squared paper.

To calculate the pressure that you exert on the ground, you need to find the force you exert and the area over which you exert it.

Place one foot on the squared paper and draw round it. By counting the squares, find the area of your foot. Convert this area into square meters ($1\,m^2 = 10{,}000\,cm^2$) then double it to account for both feet.

Weigh yourself on the scales. Convert your mass into weight using the equation $F = mg$.

Now find the pressure you exert on the ground using the equation:

$$P = \frac{F}{A}$$

Data-based question: The Eiffel Tower

The total mass of the Eiffel Tower is about 10,000 tonnes. The base of the tower consists of four feet, each of which is a square of side 25m. The tower is very efficient in its use of materials – if all the metal in the tower were melted down and placed on one of the bases, it would only be about 1.5m high. As a result of its light weight and large area of its footprint, it exerts a low pressure on the ground and so does not require deep foundations.

1. Calculate the weight of the Eiffel Tower.
2. Calculate the total area of the base.
3. Calculate the pressure that the Eiffel Tower exerts on the ground.

▶ The Eiffel Tower opened in 1889 and was the tallest building in the world for over 40 years. It has come to symbolize the Industrial Revolution in France

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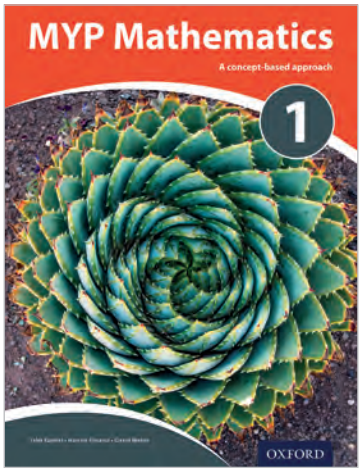
MYP Physics 4 & 5 Student Book

Mathematics



Fully adopt the MYP approach

Supporting the MYP curriculum framework, these resources strengthen mathematical understanding and develop conceptual awareness.

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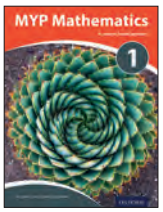

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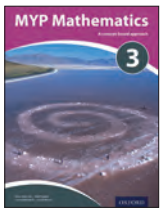

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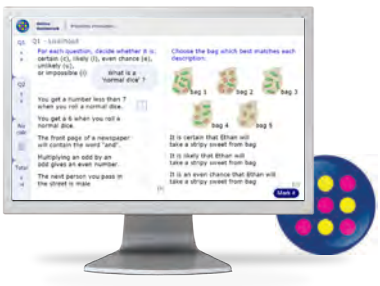


Embed understanding through practice

Reflect and discuss 9

- Which form – percentage, decimal or fraction – do you prefer when ordering numbers?
- What are the advantages and disadvantages of each form? Make a list for each one.
- How are fractions, decimals and percentages equivalent forms?

Activity 6 – Conversion bingo

Draw a 4 by 4 grid and fill it in with a combination of fractions, decimals and percentages, at least four of each. Here is an example.

Your teacher will give you the specific guidelines for what numbers you can put in your grid. (For example, you may be told that you can use any percentages that are a multiple of 10. So you must come up with decimals, fractions and percentages that as a percentage are a multiple of 10.) You cannot include two equivalent numbers in different forms (e.g. 20% and 0.2).

Once you have written the numbers in your grid, the game will begin. Your teacher will call out a number in one of the three forms and you can cross it off your grid if you have that number in any of the three forms. The winner is the first student to get four in a row, column, or major diagonal.

20%	0.4	30%	$\frac{17}{20}$
$\frac{1}{4}$	0.75	0.05	45%
10%	16%	$\frac{1}{15}$	90%
$\frac{6}{35}$	70%	0.68	$\frac{3}{5}$

Formative assessment – Food for refugees

Criteria: C, D

The United Nations High Commissioner for Refugees (UNHCR) recommends that a refugee should consume at least 2100 calories per day. Yet in many refugee camps, refugees get less than this. For example, in one Tanzanian refugee camp, refugees were given only about 1400 calories per day.

1 What percentage of the minimum daily calories were the refugees in the Tanzanian camp given?

2 In many refugee camps, refugees end up trading their food for other non-food supplies that they need. If a refugee was eating only a third of the minimum daily calorie recommendation, how many calories per day would that be?

Continued on next page

The table shows approximately what a Syrian refugee might eat *per day* in a Jordanian refugee camp. Remember that the UNHCR recommends that a person should have at least 2100 calories daily.

Food	Grams (approx.)	Calories (approx.)	Type of nutrient
rice	274	1100	carbohydrate
flour	57	230	carbohydrate
lentils	24	97	protein
dried chickpeas	12	49	protein
sardines	18	71	protein
canned kidney beans	57	229	protein
vegetable oil	43	386	fat

3 What is the number of total daily calories in this refugee diet?

4 What percentage of a refugee's calories come from protein?

5 What percentage of a refugee's calories come from carbohydrates?

6 What percentage of a refugee's calories come from fat?

7 Make a similar list of the foods that you eat in a typical day.

8 Using an online source, calculate the approximate number of calories for every item on your list and state the type of nutrient.

9 Calculate the total number of calories you consume in one day. Calculate how many calories you consume daily of fat, protein, and carbohydrates.

10 What percentage of your calories come from each of these three nutrient groups?

11 Explain the degree of accuracy of your results in step **10**. Describe whether or not your results in step **10** make sense.

12 How does your diet differ from the refugee diet? How is it similar? (Compare the number of calories, breakdown of food groups, etc.)

ATL1 13 How do you think refugees feel, having to follow this diet? Explain.

Applications of percentages

There are many practical applications involving percentages which you will see on a regular basis, such as finding the discount on an item for sale in a store or calculating the tax when purchasing an item. Remembering that percentages and fractions are really just equivalent forms can help you to solve these types of problems.

MYP Mathematics 1 Student Book

Build inquiry and problem-solving skills

5.1 Are you saying I'm irrational?

FORM

Objectives
- Simplifying irrational numerical expressions
- Approximating radicals
- Applying rules of radicals to simplify them
- Performing operations on radicals to simplify expressions that contain radicals

Inquiry questions

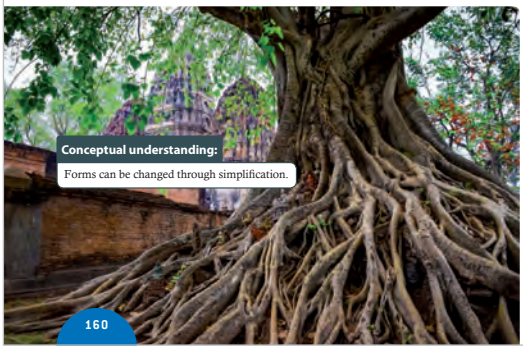
F
- What is the difference between a rational number and an irrational number?
- What is a radical (surd)?
- How do you approximate a radical?

C
- How are the rules of radicals related to the rules for combining terms in algebra?
- How is simplifying radicals similar to simplifying fractions?

D
- Can irrational numbers be combined to form rational numbers?

ATL Communication

Draw reasonable conclusions and generalizations



5.1 10.3 E5.1

You should already know how to:

- identify radicals and understand what they represent

1 Simplify each expression.
a $\sqrt{9+16}$ b $\sqrt{9}+\sqrt{16}$
c $\sqrt{3}\times\sqrt{3}$ d $11+\sqrt{11}$
e $\sqrt{3}\times\sqrt{6}\times\sqrt{8}$ f $\sqrt{\frac{1}{9}}$

F Reviewing radicals (surds)

- What is the difference between a rational number and an irrational number?
- What is a radical (surd)?
- How do you approximate a radical?

A **square root** (also known as a **radical** or **surd**) of a positive number x is a number which, when multiplied by itself, gives the original number x. Any positive number has two square roots: one positive and one negative.

The **principal square root** of a positive number x is the *positive* square root of x, and is written as $\sqrt{x}$.

In general, 'the square root' means the *positive* square root.

For example, $\sqrt{25}=5$, but the square root of 25 can also be -5. This is normally written down as $-\sqrt{25}=-5$.

Muhammad ibn Musa al-Khwarizmi (c. 780–c. 850 AD) referred to rational numbers as *audible*, and irrational numbers as *inaudible*. This later led to the Arabic word 'اصم' (asamm, meaning 'deaf' or 'dumb') for irrational number, which was then translated into Latin as 'surdus'.

Exploration 1

Here are some examples of what we call 'rational numbers':

$\frac{1}{2}$ 1.45 7.262626… -3 $\frac{5}{6}$ 18.2 $\sqrt{9}$

And here are some examples of what we call 'irrational numbers':

π 2.39841… 17.41002368… 0.83126674…

1 State the differences between a 'rational number' and an 'irrational number'.

2 Define each of them in your own words.

3 How would you classify a number like $\sqrt{5}$? Explain your reasoning.

A **rational number** is a number that can be written as a fraction $\frac{p}{q}$ where $p, q \in \mathbb{Z}$ and $q \neq 0$. For example: $\frac{1}{2}, \frac{5}{6}, \frac{9}{5}, 4, -\frac{12}{51}$ 1.2, $-0.\dot{3}$, and 0 are all rational numbers.

An **irrational number** is a number that cannot be written as a fraction. Irrational numbers *cannot* be represented as terminating or repeating decimals. $\sqrt{2}$ and π are examples of irrational numbers.

We have given names to only a few special irrationals, like π, φ, and Euler's number, e.

MYP Mathematics 4 & 5 Standard Student Book

English Language Acquisition

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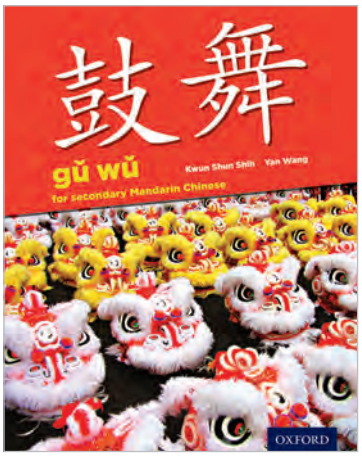

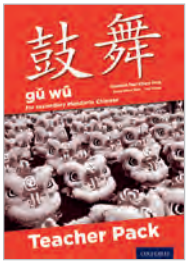

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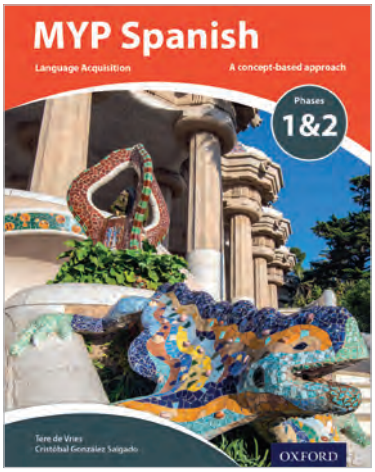
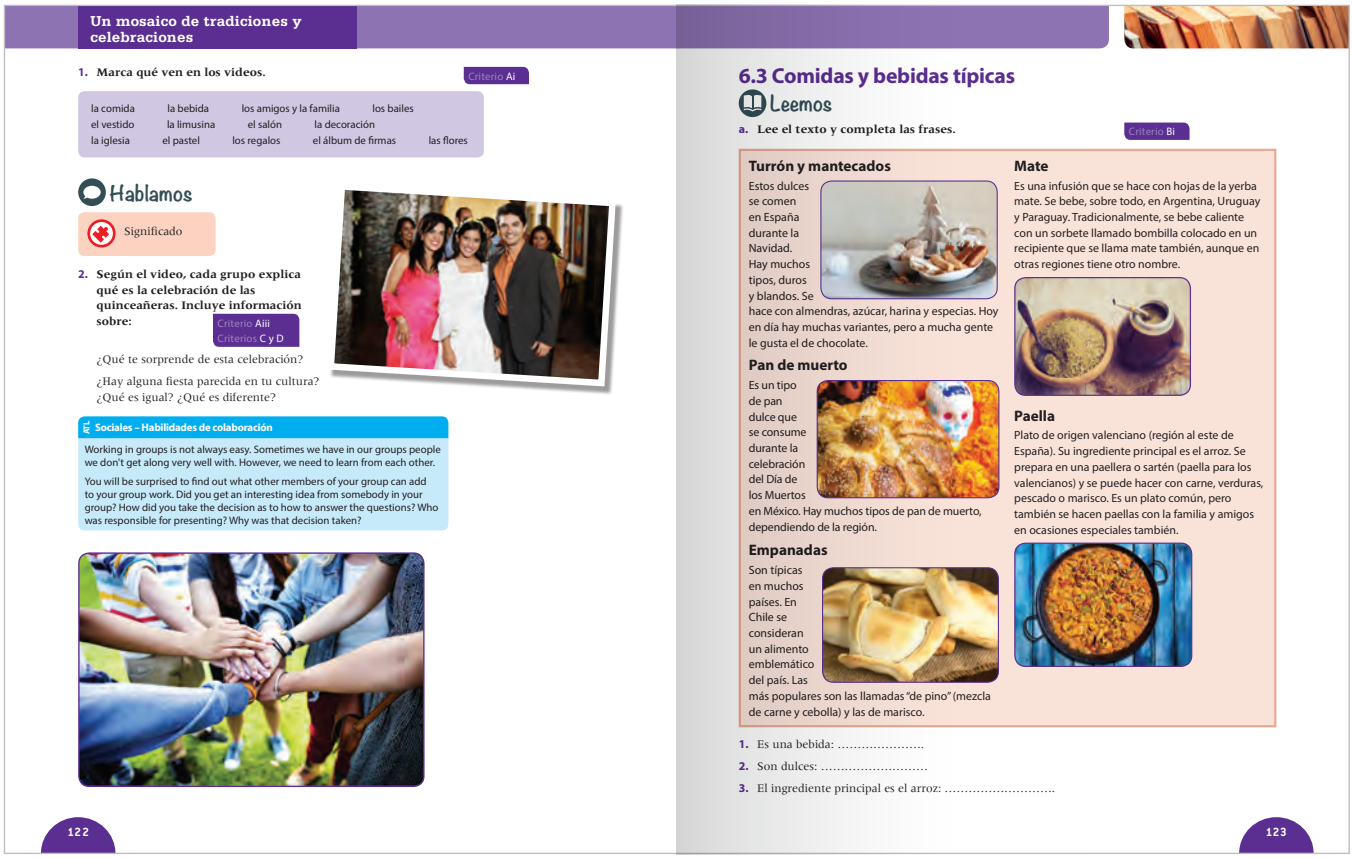
- Support achievement through regular formative and summative assessment tasks





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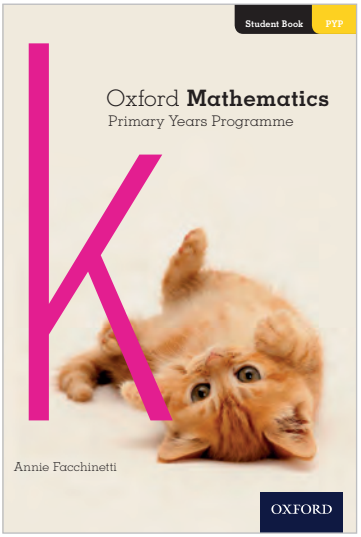

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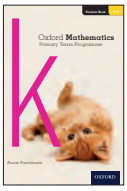
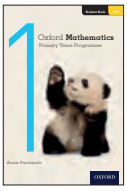
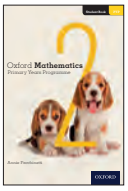
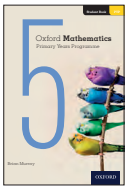
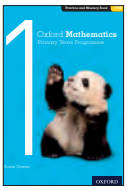
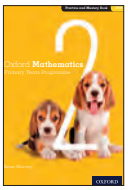
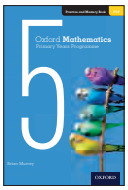
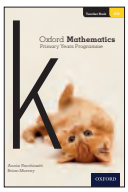
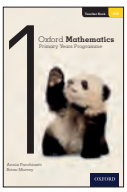
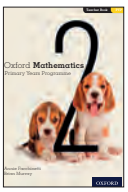
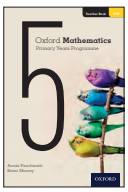
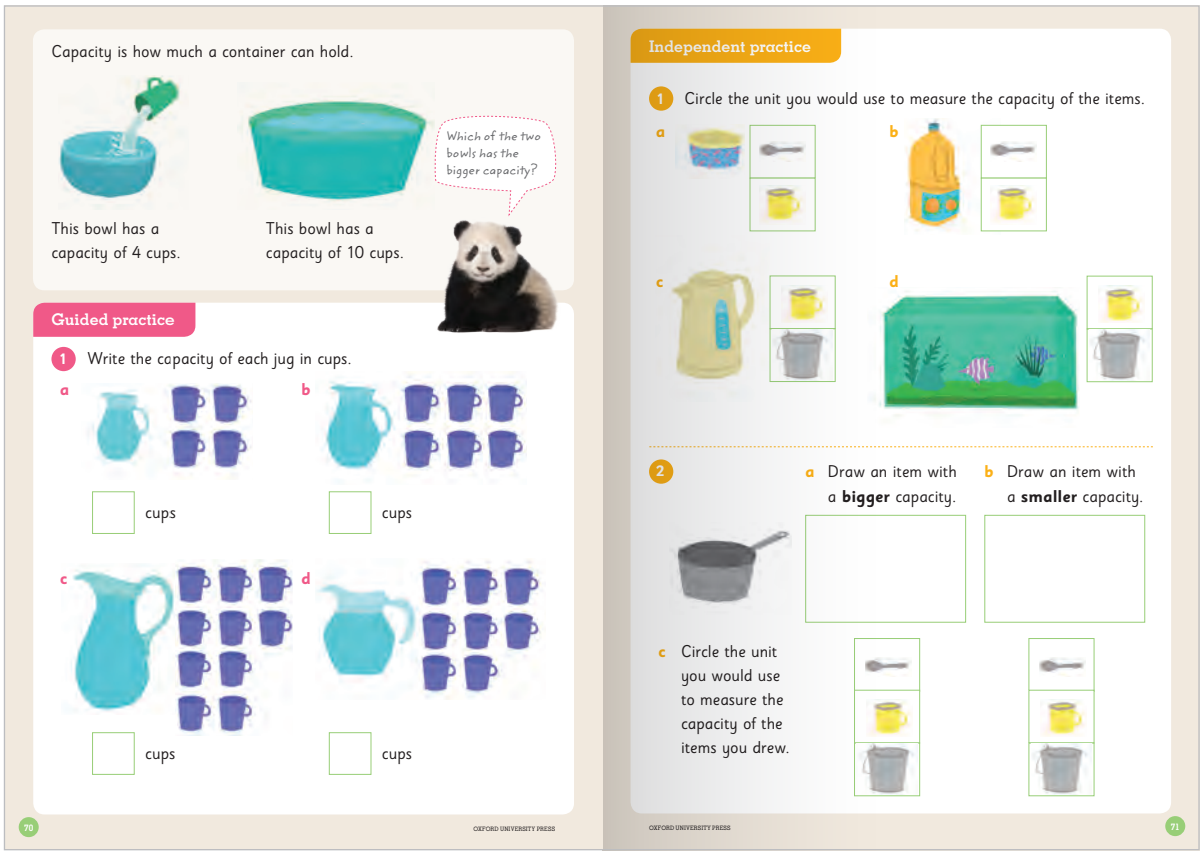
Student Books	 978 019 031219 0 £16.99	 978 019 031220 6 £16.99	 978 019 031221 3 £16.99	 978 019 031222 0 £16.99	 978 019 031223 7 £16.99	 978 019 031224 4 £16.99	 978 019 031225 1 £16.99
Practice and Mastery Books		 978 019 031226 8 £9.99	 978 019 031227 5 £9.99	 978 019 031228 2 £9.99	 978 019 031229 9 £9.99	 978 019 031230 5 £9.99	 978 019 031231 2 £9.99
Teacher Books	 978 019 031232 9 £31.99	 978 019 031233 6 £31.99	 978 019 031234 3 £31.99	 978 019 031235 0 £31.99	 978 019 031236 7 £31.99	 978 019 031237 4 £31.99	 978 019 031238 1 £31.99

Nurture independent, confident learners



Capacity is how much a container can hold.

This bowl has a capacity of 4 cups.

This bowl has a capacity of 10 cups.

Which of the two bowls has the bigger capacity?

Guided practice

1 Write the capacity of each jug in cups.

a ☐ cups

b ☐ cups

c ☐ cups

d ☐ cups

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Independent practice

1 Circle the unit you would use to measure the capacity of the items.

a

b

c

d

2 a Draw an item with a **bigger** capacity.

b Draw an item with a **smaller** capacity.

c Circle the unit you would use to measure the capacity of the items you drew.

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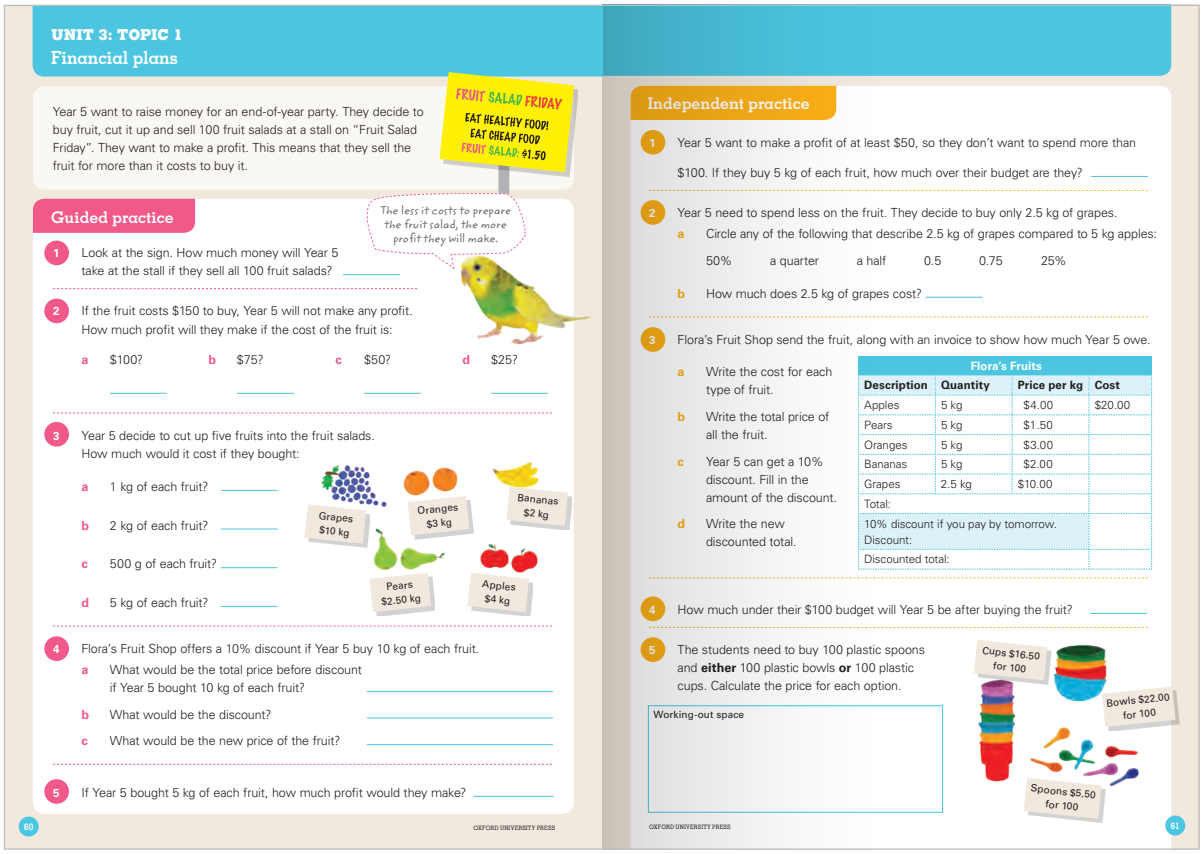
Oxford Mathematics Primary Years Programme Student Book 1

Construct, transfer and apply understanding



UNIT 3: TOPIC 1
Financial plans

Year 5 want to raise money for an end-of-year party. They decide to buy fruit, cut it up and sell 100 fruit salads at a stall on "Fruit Salad Friday". They want to make a profit. This means that they sell the fruit for more than it costs to buy it.

FRUIT SALAD FRIDAY
EAT HEALTHY FOOD!
EAT CHEAP FOOD
FRUIT SALAD: $1.50

Guided practice

The less it costs to prepare the fruit salad, the more profit they will make.

1 Look at the sign. How much money will Year 5 take at the stall if they sell all 100 fruit salads? _____

2 If the fruit costs $150 to buy, Year 5 will not make any profit. How much profit will they make if the cost of the fruit is:

a $100? _____ b $75? _____ c $50? _____ d $25? _____

3 Year 5 decide to cut up five fruits into the fruit salads. How much would it cost if they bought:

a 1 kg of each fruit? _____

b 2 kg of each fruit? _____

c 500 g of each fruit? _____

d 5 kg of each fruit? _____

Grapes $10 kg; Oranges $3 kg; Bananas $2 kg; Pears $2.50 kg; Apples $4 kg

4 Flora's Fruit Shop offers a 10% discount if Year 5 buy 10 kg of each fruit.

a What would be the total price before discount if Year 5 bought 10 kg of each fruit? _____

b What would be the discount? _____

c What would be the new price of the fruit? _____

5 If Year 5 bought 5 kg of each fruit, how much profit would they make? _____

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Independent practice

1 Year 5 want to make a profit of at least $50, so they don't want to spend more than $100. If they buy 5 kg of each fruit, how much over their budget are they? _____

2 Year 5 need to spend less on the fruit. They decide to buy only 2.5 kg of grapes.

a Circle any of the following that describe 2.5 kg of grapes compared to 5 kg apples:

50% a quarter a half 0.5 0.75 25%

b How much does 2.5 kg of grapes cost? _____

3 Flora's Fruit Shop send the fruit, along with an invoice to show how much Year 5 owe.

a Write the cost for each type of fruit.

b Write the total price of all the fruit.

c Year 5 can get a 10% discount. Fill in the amount of the discount.

d Write the new discounted total.

Flora's Fruits			
Description	**Quantity**	**Price per kg**	**Cost**
Apples	5 kg	$4.00	$20.00
Pears	5 kg	$1.50	
Oranges	5 kg	$3.00	
Bananas	5 kg	$2.00	
Grapes	2.5 kg	$10.00	
Total:			
10% discount if you pay by tomorrow. Discount:			
Discounted total:			

4 How much under their $100 budget will Year 5 be after buying the fruit? _____

5 The students need to buy 100 plastic spoons and **either** 100 plastic bowls **or** 100 plastic cups. Calculate the price for each option.

Working-out space

Cups $16.50 for 100; Bowls $22.00 for 100; Spoons $5.50 for 100

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Oxford Mathematics Primary Years Programme Student Book 5

PYP

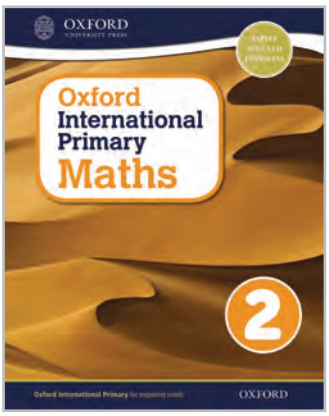
Mathematics

Science

Engage learners in scientific inquiry

- Empower learners to consider big ideas and ask questions throughout the learning process
- Actively engage students with a rich variety of activities and games, including digital resources
- Encourage learners to reflect upon and extend their learning via 'think about…' features and extension activities

Oxford International Primary Science
6 Student books, 6 Workbooks, 6 Digital Resource Packs, 6 Teacher's Guides and 1 Assessment Pack



Mathematics

Develop problem-solving skills

- Encourage learners to explore and discuss problems in the context of big questions
- Clarify mathematical concepts by relating them to examples from everyday life
- Motivate learners with a range of colorful activities and interactive digital resources

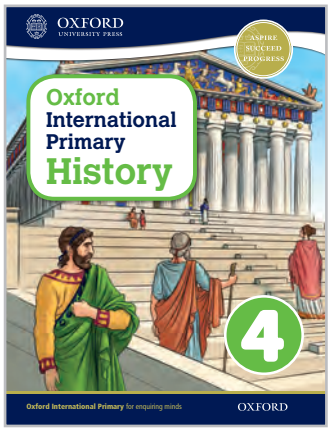
Oxford International Primary Maths
6 Student books, 6 Workbooks, 6 Digital Resource Packs, 6 Teacher's Guides and 1 Assessment Pack

Computing

Build vital skills for today's digital world

- Prepare students for the demands of the rapidly evolving digital landscape with a new sharper focus on computational thinking
- Encourage active learning with project-based work that enables students to apply their knowledge and skills in real-life situations
- Make lasting progress with in-built three-level differentiation to cater to the needs of every student

Oxford International Primary Computing 2nd edition
6 Student Books, 3 Teacher's Guides with Classroom Presentation Tool



History

Develop a spirit of inquiry

- Hone essential critical thinking skills as students learn to approach, evaluate and present historical sources
- Deliver a balanced perspective on international and local history, using suggested topics and thematic studies to prompt reflection
- Draw transdisciplinary links between history and geography – promoting an awareness of wider connections and concepts

Oxford International Primary History
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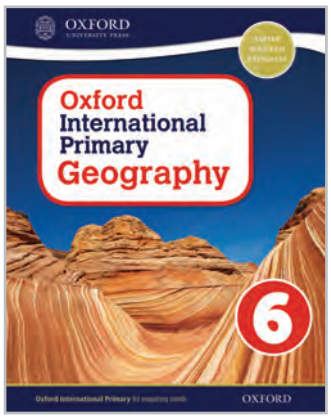
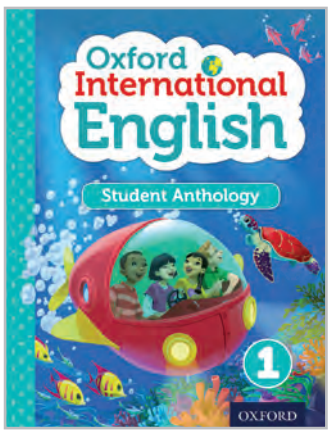


Geography

Nurture a global perspective

- Help learners to relate their local environment to a wider global context
- Facilitate cross-curricular projects through suggestions and guidelines on research topics
- Use real-life, international examples to bring key aspects of geography to life

Oxford International Primary Geography
6 Student Books, 6 Workbooks and 1 Teacher's Guide



English

Promote exploration and reflection

- Introduce learners to a wide range of ideas and cultures, using age-appropriate fiction and non-fiction from around the world
- Develop reading, writing, speaking and listening skills via varied and colorful activities
- Encourage confident reflection with plenty of opportunities for discussion and inquiry

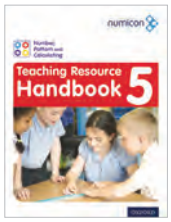
Oxford International English
6 Student Books, 2 Activity Books, 4 Workbooks, 2 Anthologies and 6 Teacher's Guides

Mathematics

Take a hands on approach

Facilitating an active, multi-sensory approach, Numicon allows learners to explore mathematics using structured imagery, apparatus and step-by-step activities.

- Build learners' confidence when problem-solving by showing how and why they arrived at their answers
- Develop understanding by applying real-life contexts to activities
- Effectively monitor learners' progress using flexible assessment tools



Numicon apparatus in use

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