Geography for CCEA

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Colourpoint Educational

CCEA Rewarding Learning

A2 LEVEL

Contents

B1 SUSTAINABLE DEVELOPMENT

The concept of sustainable development arose from the 1992 Earth Summit in Rio. It refers to development "that meets the needs of the present without compromising the ability of future generations to meet their needs|" (Bruntland Report 1987). At the Earth Summit in Rio it was agreed that all nations should adopt a sustainable development strategy for the twenty-first century. This became known as Agenda 21 (see p64). The UK was one of the first countries to adopt these principles, publishing the *Sustainable Development Strategy* in 1994 and *A Better Quality of Life: A Strategy For Sustainable Development in the UK* in 1999.

The total world population currently stands at 6.7 billion, with more than 5.5 billion residing in LEDCs. Approximately 2.9 billion people or 47% of the world's population live in urban areas and especially in the very large cities.

The global economic situation is changing and countries like China and India, both with large populations, have made dramatic economic progress in the last decade. These recently industrialised nations will make demands on scarce resources and contribute to waste generation. Sustainable development is especially challenging in relation to settlements because they alter all components of the natural environment including drainage basins, forests and water resources. Economic activities in settlements have caused environmental damage to the atmosphere, resulting in global warming and acid rain; pollution of rivers and oceans; and generated large amounts of waste, much of which is non-biodegradable.

In MEDCs economic development was often based on the exploitation of finite reserves, mineral resources and fossil fuels, with little regard for the potential repercussions for the environment or the health of the local communities. When coal mining declined in Britain whole communities experienced social and economic difficulties associated with unemployment along with the environmental consequences of derelict buildings and waste tips. With limited alternative employment opportunities and lacking the skills required for modern industry, many people remained unemployed for long periods. Such unemployment has a knock on effect on other sectors of economic activity. A decrease in disposable income has a negative impact on those dealing in non-essential items. Gradually these areas become economic blackspots and can go into a downward spiral of decline. Research shows that personal morale diminishes in these circumstances and a raft of social problems often follows including family splits, poor educational attainment and vandalism. In other words these settlements, built and developed during the boom years of a single industry, such as coal mining or shipbuilding, were not sustainable.

Other settlement issues challenging sustainable development relate to urban sprawl where new residential, retail and industrial developments encroach onto the rural urban fringe, resulting in increased pollution from traffic and a reduction in biodiversity. Many inner city areas have become run down as developers seek more attractive Greenfield sites for development.

Exercise

Study figure ??. Using the website sourced below the table, research this ward more fully. Discuss the evidence that shows that this ward was not developed in a sustainable way.

Figure 1

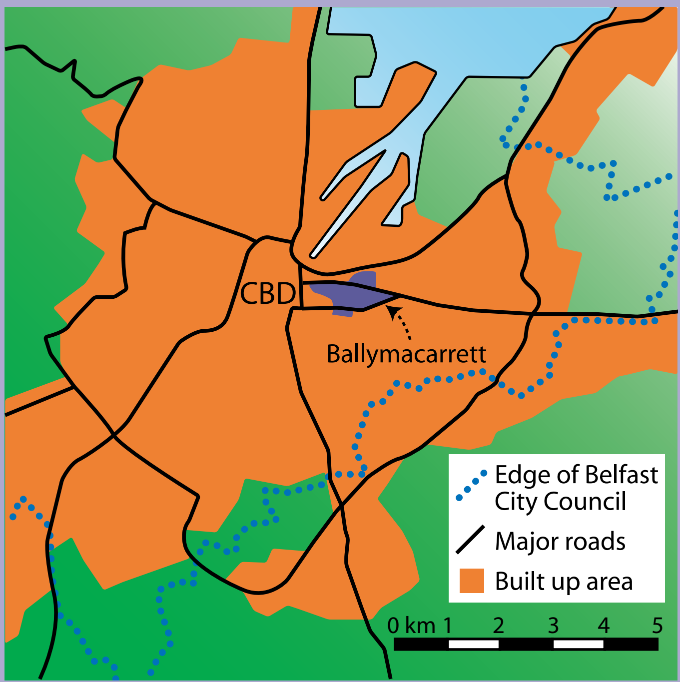
Social and economic data for Ballymacarret (inner city) and Belfast

Indicator	Ballymacarret	Belfast
% 16 year olds with 5 GCSE grade C	24	58
% Unemployed	9.3	5.4
Multiple Deprivation Rank*	9	n/a
Life expectancy	70	74
% Housing owner occupied	27	56

Source: http://www.ninis.nisra.gov.uk/mapxtreme/report.asp?DESC=FromGeneral&CurrentLevel=WARD&ID=95GG04&Name=Ballymacarrett

* Multiple Deprivation Rank – all 582 wards in Northern Ireland are ranked according to their level of deprivation. Rank 1 is the most deprived and rank 582 is the least deprived.

Figure 2



In the Sustainable Development Strategy in 1994 and again in 1999, the UK government set to deliver sustainability through three main areas: society, the economy and the environment. For each area a number of guidelines were published and much of the planning and delivery of the programmes for sustainable development was carried out by local government bodies.

Social considerations

In settlements a sustainable society should aim to incorporate the following guidelines in planning proposals:

- Provision of good quality housing, health and recreational facilities.
- Address poverty and social exclusion in the more deprived areas.

- Improve local surroundings, especially the areas of industrial decline.
- Ensure that the character of the countryside is maintained.
- Establish partnerships with local organisations to promote community involvement.

Economic considerations

In order to achieve sustainable economic development in settlements it is necessary to:

- make better use of existing resources;
- create a stable and competitive economy;
- develop a range of economic activities to prevent over reliance on one industry;
- develop a workforce with the appropriate skills that can adapt to change;
- aim to achieve increased efficiency in the production of goods and in the provision of services to the local community;
- encourage cooperation across all sections of the community.

Environmental considerations

Environmental concerns are perhaps the most challenging of all the targets for sustainable development. The key areas are:

- cutting greenhouse gas emissions and improving air quality;
- promoting the development and supply of renewable energy at competitive prices;
- improving waste management including recycling;
- safeguarding water resources;
- reversing the damaging trends that threaten landscapes and wildlife;
- working with other nations to tackle global challenges such as climate change.

In order to monitor progress on sustainable development the government have developed a number (150) of sustainability indicators in line with the principles of Agenda 21. **Resource 35** includes a sample of the indicators.

Resource 35 *Selected Sustainability Indicators*

- Level of crime
- Number of days when air pollution is moderate or high
- Number of rivers of good or fair quality
- Number of new homes built on previously developed land
- Percentage of waste that is recycled

Delivering sustainable practices requires financial input from central government. In the UK the government has attempted to raise money from taxes levied on key polluters, such as added tax for air travel and increasing vehicle licensing duty on cars with a high fuel consumption rate. A considerable amount of money has been invested in campaigns to raise public awareness of the issues concerned. A Sustainable Development Commission has been established to manage national and local sustainable development policies in the UK as well as promoting a global perspective on this issue.

Additional References

Sustainable Development Commission

http://www.sd-commission.org.uk/

Useful articles on this topic are available from the following website:

http://www.ace.mmu.ac.uk/Resources/Fact_Sheets/Key_Stage_4/Sustainable_Development/index.html

Urban ecological and carbon footprints

World population has increased dramatically in the twentieth century and so too has the demand on the Earth's resources. With increased affluence in MEDCs the demand for consumer goods has increased. In a global society it is possible to import from abroad and cheap airfares enables more international travel. Increasing amounts of waste are being produced and more finite resources used up. According to figures published by the United Nations it would take the equivalent of 1.3 planets to provide the resources we use in every day life and to absorb our waste for one year. This means that it takes the Earth one year and four months to produce what we use in one year. The UN also predicts that if current population and consumption trends continue, by 2030 we will need the equivalent of two Earths to support us! Turning resources into waste faster than waste can be turned back into resources threatens global ecosystems, and causes pollution, global climate change and food shortages. Many organisations, including the UN, have been proactive in formulating measures to ensure we live more sustainably. In particular, the environmental impacts of urban areas are of much concern because a growing proportion of the world's population lives in cities.

Ecological and carbon footprints are methods used to evaluate sustainability measures in an area and enable comparisons to be made between regions. The ecological footprint refers to the total number of hectares (global hectares) required to provide an area with all of its needs including farmland, fuel and water resources, as well as the amount of land required to absorb its carbon dioxide and other waste. This figure is then compared to the actual area of the region. The ecological footprint is really a measurement of the land area required to sustain a population of any size. Ecological footprints can be measured at any scale from individual level to global level. Because cities have high density populations, normally associated with industry and high levels of car ownership, the ecological footprint for a city is usually many times larger than the physical area of the city. In 2002 an organisation known as City Limits published the ecological footprint for London. Their results are summarised in **Resource 36**.

Resource use and waste generation in London 2000 — ***Resource 36***

- The population of Greater London in 2000 was 7.4 million.
- Londoners consumed 154,400 GigaWatt hours (GWh) of energy (or 13,276,000 tonnes of oil equivalent), which produced 41 million tonnes of CO_2.
- Londoners consumed 49 million tonnes of materials. On a per capita basis, this represents 6.7 tonnes.
- 27.8 million tonnes of materials were used by the construction sector.
- 26 million tonnes of waste were generated.
- 6.9 million tonnes of food was consumed, of which 81% was imported from outside the UK.
- Londoners travelled 64 billion passenger kilometres (pass–km), of which 69% was by car.
- Water consumption reached 876,000,000,000 litres, of which 28% was leakage.

Source: adapted from data published by www.citylimitslondon.com

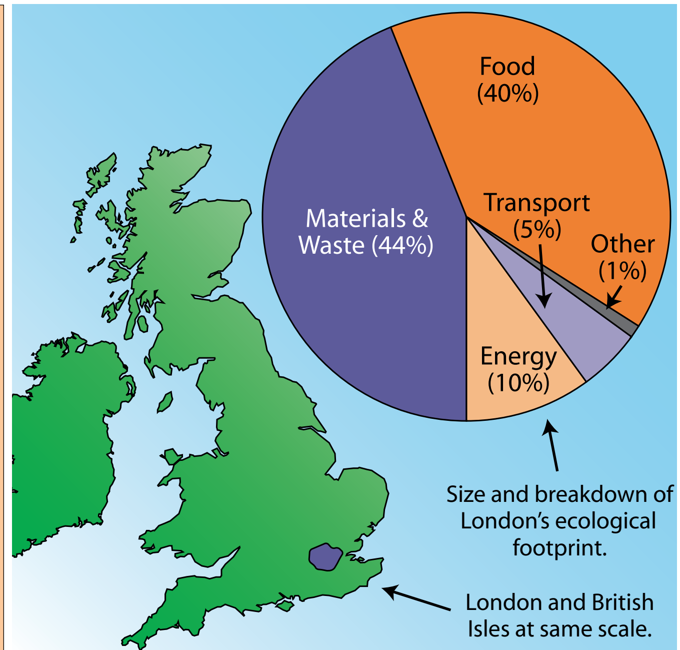
Based on this consumption of resources it is possible to calculate the area or global hectares of land required to provide Londoners with these resources. This area is then compared to the biocapacity or resource production in London. The individual ecological footprint is calculated by dividing the total population of London by the total global hectares.

Resource 37 *Ecological Footprint for London 2000*

- The ecological footprint of Londoners was 49 million global hectares (gha), which was 42 times its biocapacity and 293 times its geographical area. This is twice the size of the UK, and roughly the same size as Spain.
- The ecological footprint per London resident was 6.63 gha. This compares with the UK average ecological footprint of 6.3 gha, and exceeds the global average' of 2.18 gha.
- The ecological footprint of London tourists was estimated at 2.4 million gha, which equates to an additional 0.32 gha per Londoner.
- The proposed global average for 2050 is targeted at 1.44 gha per capita. For Londoners to be ecologically sustainable by 2050, a 35% reduction by 2020 and an 80% reduction by 2050, of their ecological footprint will be needed.

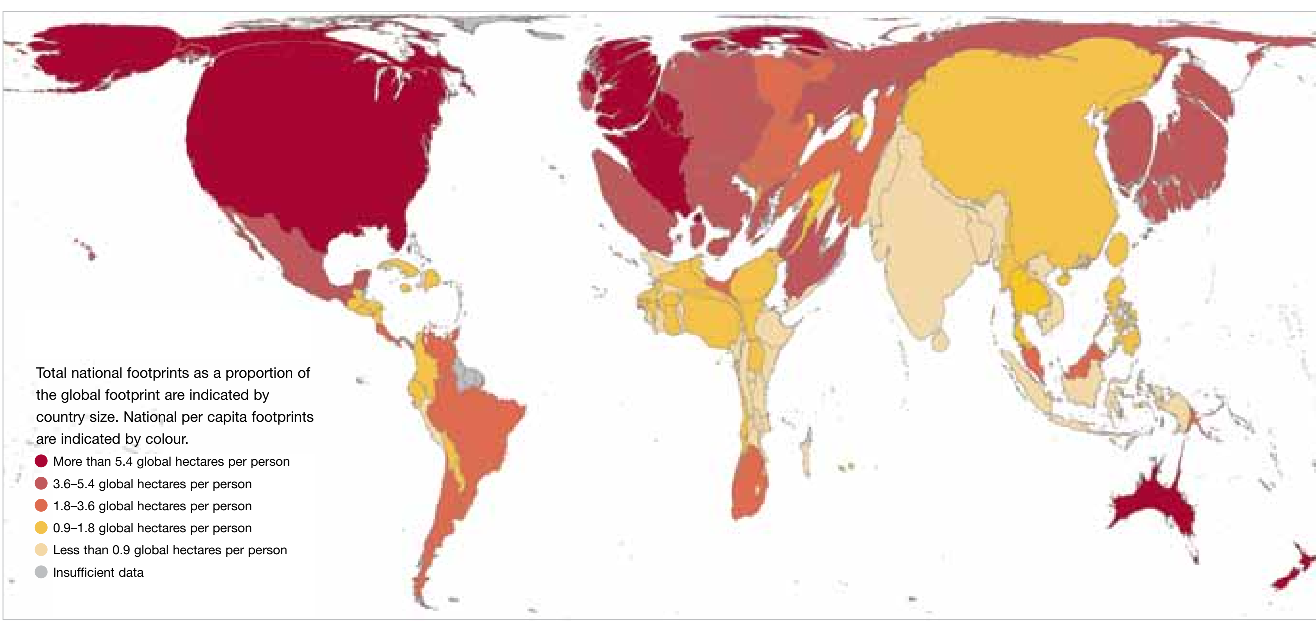
Source: Adapted from data published by www.citylimitslondon.com

Resource 38 *Ecological footprint for London by component, showing its size in the UK*



Source: Adapted from data published by www.citylimitslondon.com

Resource 39 *National ecological footprints as a proportion of the global footprint*



Source: Living Planet Report 2006, WWF International. Used with permission.

Exercise

1. Northern Ireland's ecological footprint is 5.63 gha. What does this figure mean?
2. Study the information relating to Ecological Footprints in the USA and Chad in figures 1–4.

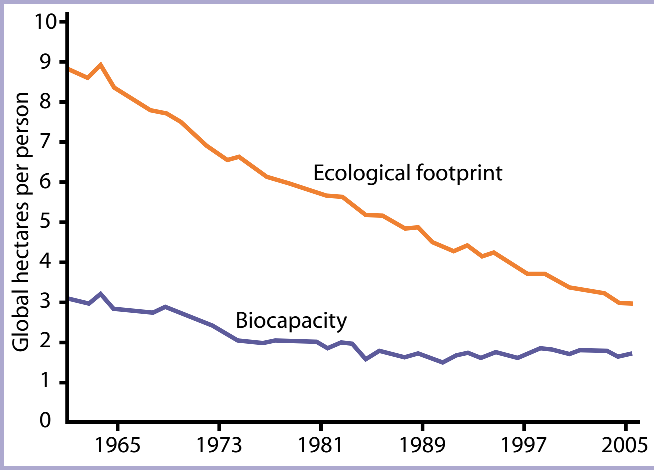
   (a) Describe the relationship between resource demand (ecological footprint) and resource supply (biocapacity) in both countries.

   (b) Contrast the ecological footprints of Chad and the USA.

Exercise continued

Figure 1

Resource demand (ecological footprint) per person and resource supply (biocapacity) in Chad 1961–2005



* Biocapacity varies each year with ecosystem management, agricultural practices (such as fertilizer use and irrigation), ecosystem degradation and weather.

Figure 2

Components of the ecological footprint per person in Chad 1961–2005

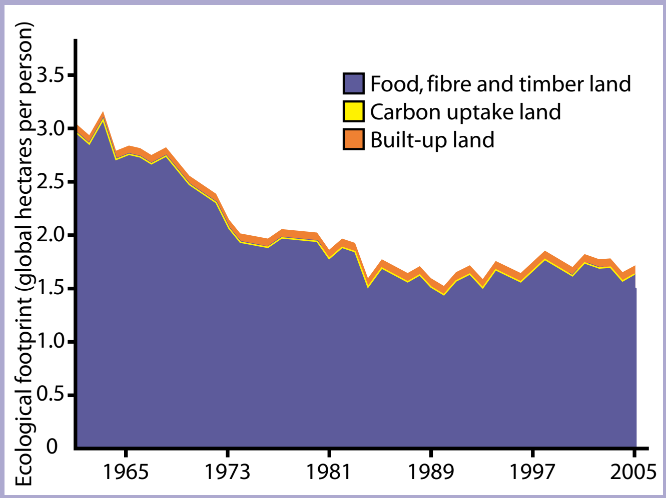
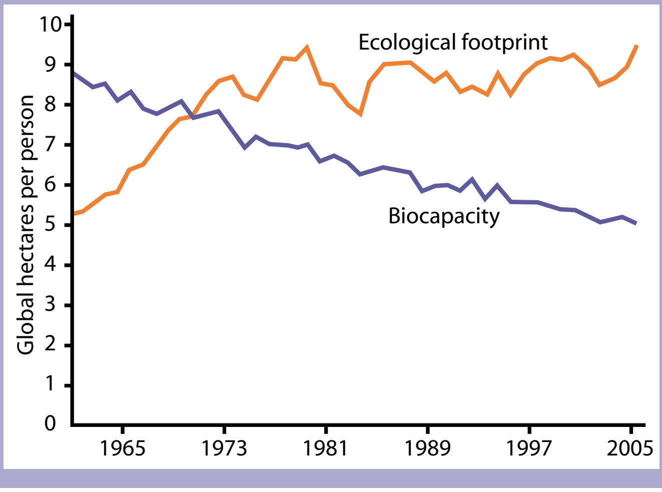


Figure 3

Resource demand (ecological footprint) per person and resource supply (biocapacity) in USA 1961–2005.



A3 COASTAL PROCESSES, FEATURES AND MANAGEMENT

While the term 'coastal zone' is generally understood it is hard to define. It is where the land meets the sea but, despite decades of debate, its offshore and landward boundaries are difficult to determine. What is agreed is that the coast represents a dynamic, ever changing environment, in which the features and processes of the land meet the vibrant fluid dynamics of the sea. At any one point in time the landforms created along this distinctive boundary represent a dynamic equilibrium between the nature of the land, the forces of the sea and human activity. At a simple level it can be said that the land provides the material for coasts; rock and sediment, while the sea provides the energy to form and shape these materials. The coast then is composed of features of erosion, such as cliffs, and/or features of deposition, such as beaches and dunes.

The energy from the sea

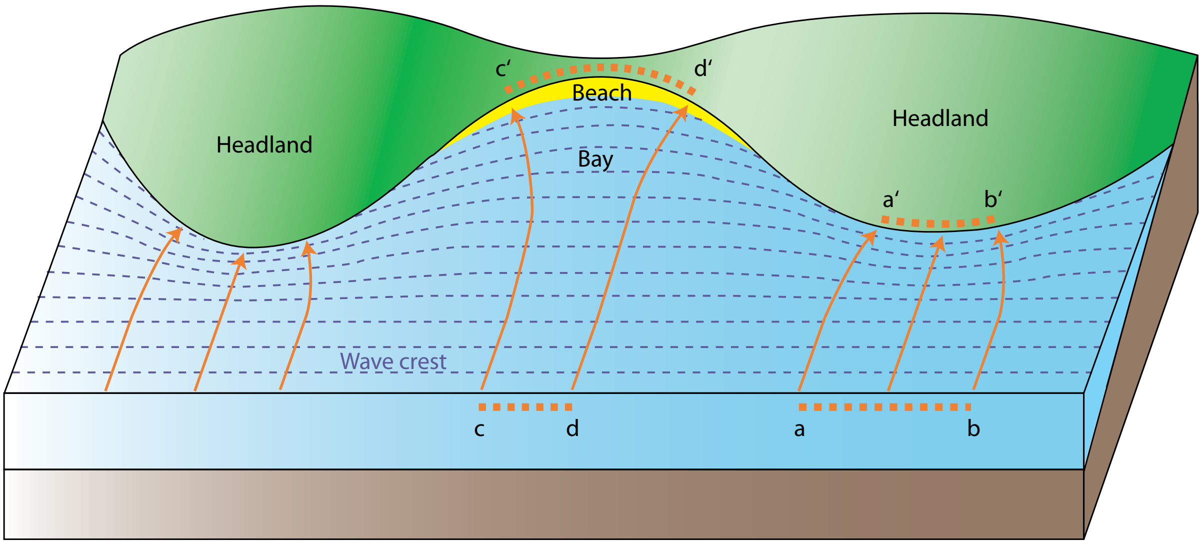
Waves, tides, currents and changing sea-level provide the flows and forces to modify and alter the shore. Coastal environments vary greatly over time and space. Twice daily tides, generated by the gravitation of the moon and sun, sweep across the coastal zone, constantly altering the point at which waves arrive. The coast of Western Europe has some of the highest tidal ranges in the world, meaning that, at low tide, huge stretches of land may be exposed, only to be covered again in a few hours. Waves are created by wind blowing over water and they transfer energy across the oceans until they reach land. Waves vary in their nature and impact. Steep, plunging waves may cause severe erosion of the coastline, while shallower but powerful surging waves may carry sediment onshore.

The nature of waves

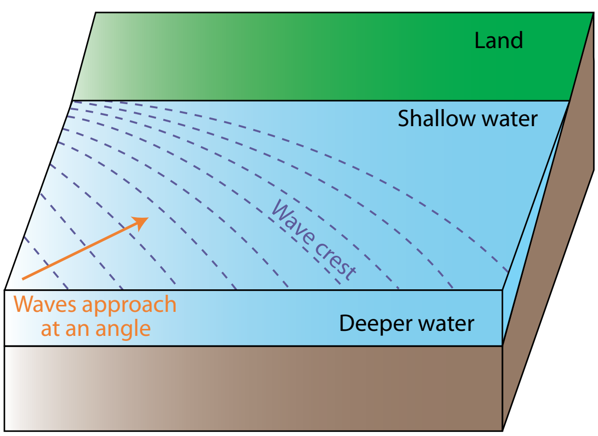
Sea waves are generated by the friction of winds blowing over the open sea. The power of a wave reflects the speed of the wind and the time and distance (**fetch**) over which it blows. This is why waves on the west coast of Ireland tend to be powerful, as they can be generated across the width of the Atlantic Ocean. Waves in deep water merely transfer energy; think of sending a wave shape along a piece of rope you are holding. When waves enter shallower water near the coast an important change takes place. Friction with the seabed slows the base of the wave until it breaks, throwing water forward onto the shore – the **swash**. The same water then runs back down the shore – the **backwash**. The relative power of the swash and backwash will determine if each wave deposits or erodes material from the shore. The precise nature of a wave or wave train (as a group are called), varies according to variables of the wind and shoreline. In European winters storms often form high energy plunging waves, termed **destructive waves**, which commonly remove material from the shore making beaches steeper. In summer gentler winds create low energy waves that push material onshore adding to beaches. These are termed **constructive waves**.

An important relationship with coastlines is the direction from which waves approach. At first it would appear that this will be determined by wind direction. For example, to the west of Ireland the most persistent winds are from the south west so waves will commonly come from this direction. However, as waves approach the land and shallower water, the shape of the seabed will alter their form and, as they slow down, they often become increasingly parallel to the shape of the coastline. This is known as wave refraction (**Resource 25 and 26**).

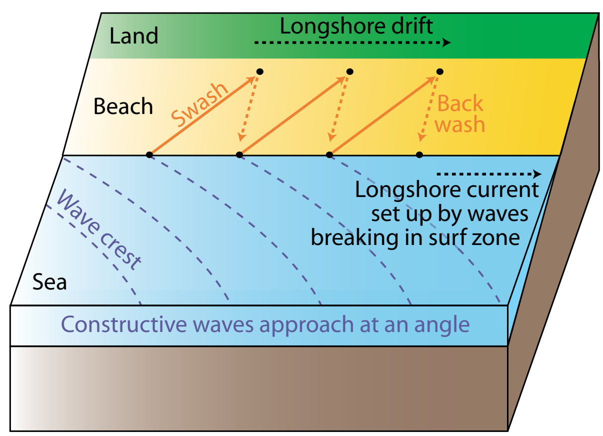
Wave refraction concentrating energy onto headlands **Resource 25**



A wave front turning to parallel the shore **Resource 26**



Long Shore Drift **Resource 27**



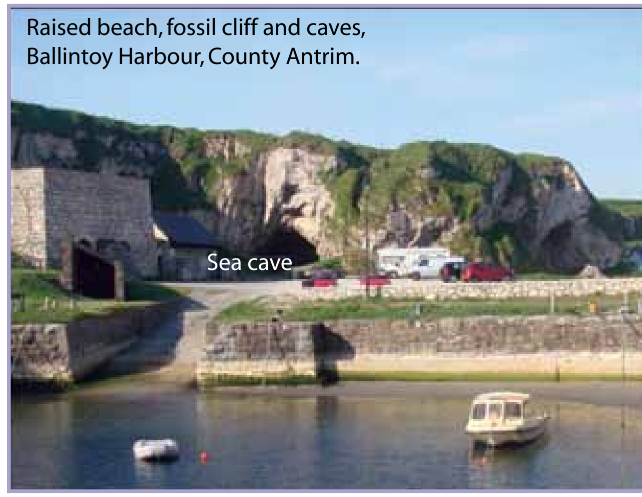
Despite refraction, waves often reach the coast at an angle to the shore. In these cases the swash will break at an angle, and on a beach they will carry water and sediment up the beach at the same angle. The backwash, under gravity, will run directly down the beach to the sea. This sets in place a process known as **long shore drift** (LSD), by which material, such as sand, is moved along the coastline in a zigzag or saw tooth manner (**Resource 27).**

Sea-level changes

Another complication to the story of coasts is the reality that the level of the sea in relation to the land is not a constant. On a global scale, world sea level is rising as a consequence of a warming climate but in the past a series of ice ages has meant ocean levels have changed repeatedly. Such worldwide sea level adjustments are termed **eustatic** change. However, not all sea level change is worldwide. On a local scale, vertical change in land height does occur. One example is **isostatic change**. Land under deep ice, such as Greenland today, or Northern Europe at the height of the last ice age, will be depressed down under the sheer weight of the ice pack. When this burden is removed, the ice melts and the land will slowly rise upwards. The north coast of Northern Ireland is still slowly recovering and as a result former beaches, cliff lines, caves and other coastal features can now be seen high and dry above modern sea levels around the Antrim coast (**Resource 28**).

Resource 28 *Former cliffs, raised beaches and arches in Northern Ireland*


Red Arch, a natural raised sea arch.
Red Bay, County Antrim.



Raised beach, fossil cliff and caves,
Ballintoy Harbour, County Antrim.


Raised beach and cliff line between White Park Bay
and Ballintoy Harbour, County Antrim.


Fossil stack near Ballintoy,
County Antrim.

Elsewhere in Northern Ireland the consequence of rising sea levels in the past can still be observed. In the shallow sea inlet of Strangford Lough the numerous islands and pladdies (shallows exposed at low tide) are the result of the sea drowning the rolling drumlin hills of that part of County Down (**Resource 29**).

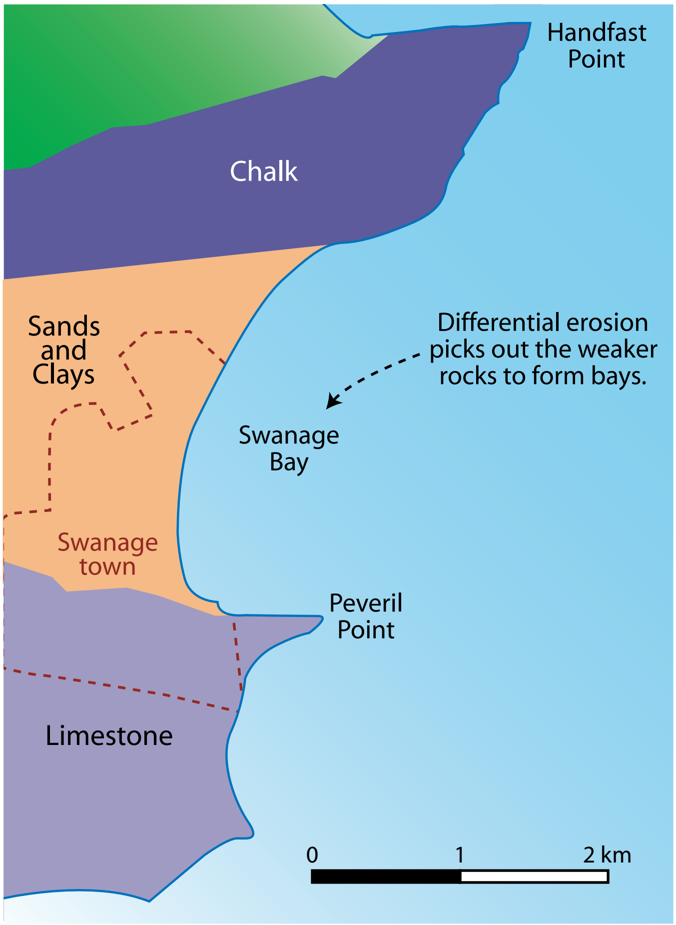
Resource 29 *Islands and pladdies along the western shore of Strangford Lough, County Down.*

The nature of the land

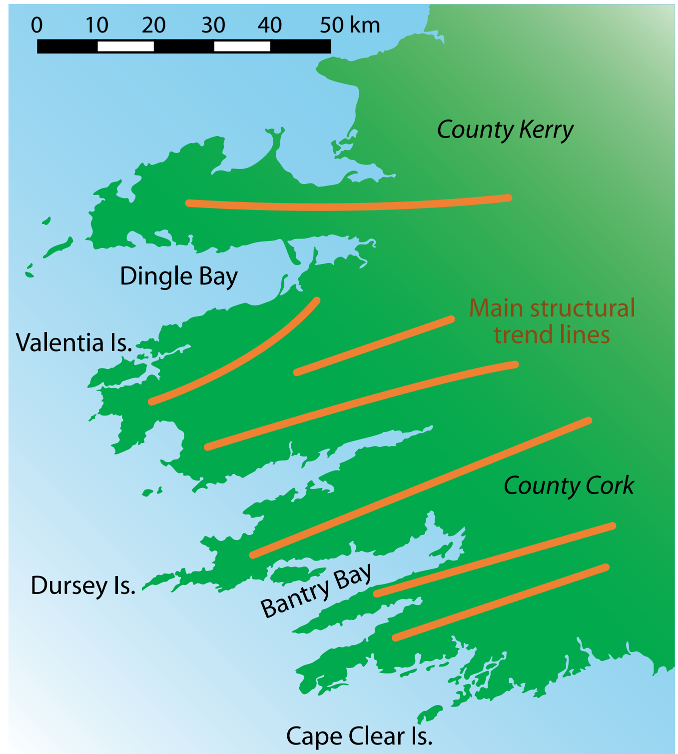
The geology of the coastline is a key factor in determining the outcome of the interaction between land and sea. At its simplest, rocks may be classified as those that are easily eroded and those that resist erosion. Often it is the arrangements of the rocks that guides the coastline that is formed. Alternating bands of hard and softer rock running at right angles to the shore can form a headlands and bay topography over time.

Differential erosion rates will also be associated with existing weaknesses in geology such as fault lines or the existence of river or glacier valleys. The distinctive indented coastline of southwest Ireland, Western Scotland and Western Norway are all the consequence of the sea invading and eroding valleys that were created by glaciers (**Resource 31**).

Headlands and bays formed by alternating bands of rock **Resource 30**



The indented coastline of Southwest Ireland **Resource 31**



The processes of erosion

Both the sea and the atmosphere are at work on the coast to breakdown the rocks that form the shore. The sub-aerial processes of weathering – mechanical, biological and chemical – will all operate here. On rock faces freeze-thaw weathering will cause rocks to fall to the foot of cliffs; plant roots and wildlife can widen cracks and weaknesses in rocks; and the dissolving of calcium carbonate by rainfall will continue in limestone deposits. The coast has some special forms of mechanical and biological weathering processes. The abundance of sodium and magnesium compounds at the coasts produces salt weathering. As these compounds crystallize out and expand in the cracks and joints of the rocks they widen these lines of weakness. The repeated wetting and drying of rocks by the advance and retreat of tides produces water-layer weathering. Marine organisms such as mollusks, sea urchins, sponges and boring worms biologically attack rock surfaces along the shore. Waves use their chemistry and energy to erode coastlines in four specific processes: hydraulic action, abrasion, solution and attrition.

- **Hydraulic action** occurs when the air in cracks in the rocks is compressed by the force of breaking waves. As the wave subsides this air expands again and these pressure changes can open the joints and weaken the rock. The sheer weight of waves hitting rocks can send shock waves of 30 tonnes per m^3 through the cliff. This is known as **wave pounding**.
- **Abrasion** is a highly effective form of erosion along exposed coastlines. Waves throw sediment, including sand, gravel and boulders, against the base of cliffs, wearing them back. Abrasion and Hydraulic action are both concentrated between the high and low tide marks.
- **Solution** results from salts and acids in the seawater attacking the chemistry of rocks. It is particularly effective on lime-rich strata.

Resource 32 *Erosion processes acting on coastal cliff lines*

WAVE EROSION PROCESSES
- Hydraulic Action
- Abrasion
- Attrition
- Solution

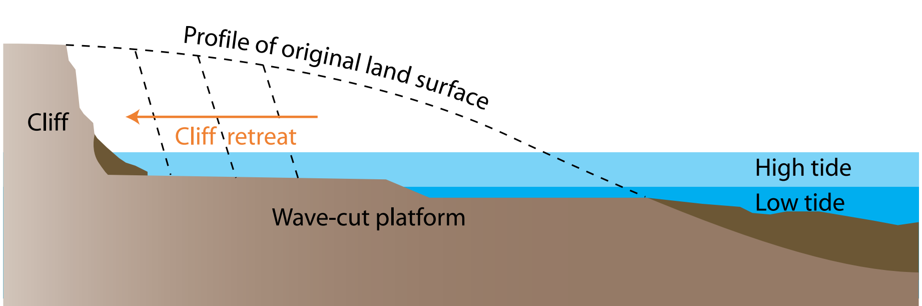
SUBAERIAL PROCESSES
- Salt weathering
- Freeze-thaw
- Wetting/drying
- Biological

- **Attrition** involves the wearing down of the material eroded from the cliffs. It provides the tools used in abrasion as well as the sediment that forms depositional features. The rapidly rounding and polishing of beach materials, including broken glass, is evidence of the effectiveness of this process.

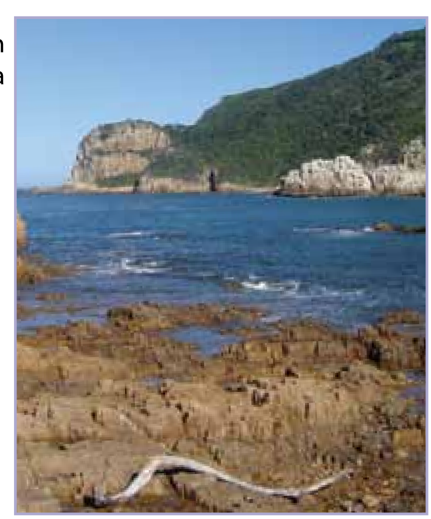
Landforms of erosion

The primary coastal landform associated with erosion is the cliff or cliff line. This is a break in slope between the land and sea that may be low and gentle, or high and steep. Cliffs are the outcome of sustained erosion along the shore and active cliffs are associated with retreating coasts. The diagram, (**Resource 33**) illustrates how cliffs are formed and how they grow in size as the coastline retreats, creating the related feature of the wave-cut platform. Erosion is focused in the relatively narrow zone between high and low tide. At this point a small notch will form as material is weakened and removed. Over time this wave-cut notch will undermine the rock above and collapse will occur. The fallen material can prevent further erosion for a time along the cliff base but eventually attrition and other marine erosion processes will remove this material and erosion of the cliff base will be renewed. Gradually the cliff face retreats and the residual wave-cut platform, often covered by sediment, is widened. The rate of cliff retreat, assuming the wave energy conditions are unchanged, will slow over time as waves will have further to travel across the wave-cut platform before reaching the cliff base. Finally, sea erosion

Resource 33 *Diagram and photograph of cliff and wave-cut platform formation*



A wave-cut platform in South Africa



of the cliff base may virtually cease and cliffs become degraded by sub-aerial processes. In the UK rates of cliff retreat of 50 cm a year are not uncommon, while the government regards rates of 100 cm or more per year as a cause for concern.

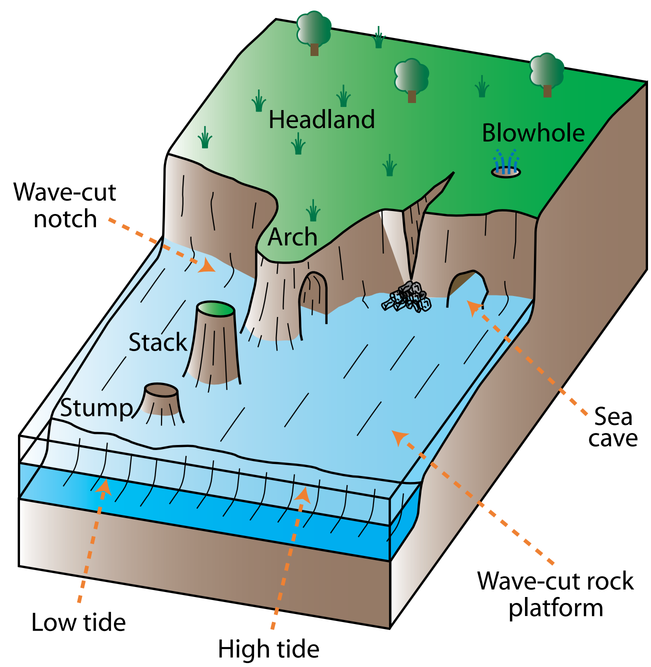
The precise cross-section shape and plan form of a cliff depends on wave energy and the nature and structure of its geology. Hard rocks that are horizontally bedded can form vertical cliffs, such as the 210 m high shale and sandstone Cliffs of Moher in western County Clare. Softer geology or rocks that dip towards the sea create more gentle profiles. The cliffs along the coast of Holderness in Eastern England are formed in unconsolidated (loose) glacial mud and are among the most rapidly retreating in the world.

Earlier in the discussion of wave refraction (**Resource 25**) it was demonstrated that wave energy can become focused onto headlands and in such settings a series of distinctive erosion landforms is often found.

Headlands, arches and stacks

The coastline of Ulster has many dramatic erosion landscapes. At Fair Head (Benmore), County Antrim, a band of hard volcanic rock known as a sill juts dramatically out into the North Channel. To the south, along the County Antrim coast, each of its famous Glens is separated by headlands and promontories, between which lie long curving bays and beaches. Many headlands show the impact of concentrated wave erosion at their base, where a wave-cut notch is evident, especially at low tide. Where there are weaknesses in the geology, faults, jointing or weaker strata, the sea will widen and open **caves**. Caves in a headland can be worn backwards ,perhaps to meet a similar feature on the opposite side. Where this happens a hole through the headland leaves the upper rock spanning an **arch**. Ongoing erosion, both by waves and sub-aerial processes, will widen the arch, undermining the spanning rock until it collapses to the sea below. The remaining part of the headland is now separate from the land and often surrounded by the sea as a **stack**. Even stacks in their turn will be eroded and reduced to **stumps** of rock that only appear at low tide. **Resource 34** and **35** describe and illustrate examples of these features of coastal erosion.

Illustration of headlands, arches and stacks ***Resource 34***



The collapse of an arch is a dramatic event and several have happened in recent decades including the collapse of one of a double arch known as the London Bridge, in a headland in southeast Australia. Well known stacks include the Old Man of Hoy, in the Orkneys and a series of stacks off the coast of the Isle of Wight called the Needles. At White Rocks in County Antrim there are a number of caves, arches and stumps, including the Wishing Arch (**Resource 35**).

Other landforms of erosion that can be seen at coastlines include **blowholes** and **geos**. These may form in headlands or along cliffs. A blowhole, as the name might suggest, involves the blowing out of water at the top of a cliff. This is the result of the sea eroding a hole in the roof of a cave. At high tide waves sweep into the cave and force air and water out through this hole. These dramatic features can be short lived as erosion continues. A geo is a narrow, steep sided inlet that may have been a constricted cave in which the roof has collapsed.

In order to satisfy the laws of physics, it is not possible to have processes of erosion without the production of sediment. This sediment will have to be transported and deposited somewhere. While some of it is carried offshore into deeper water, much is moved along the shoreline to lower energy environments, where it is deposited forming other distinctive coastal landforms.