The Coastal System

Coastal systems are the areas where the land meets the sea. And they're almost as exciting as they sound...

Coasts are Natural Systems

Coasts are **systems** — they have **inputs**, **outputs**, **flows** and **stores** of **sediment** and **energy** (see p. 2):

1) **INPUTS** — e.g. **sediment** can be brought into the system in various ways (see next page). **Energy** inputs come from **wind**, **waves**, **tides** and **currents** (see below).
2) **OUTPUTS** — e.g. sediment can be **washed out to sea**, or deposited **further along** the coast.
3) **FLOWS/TRANSFERS** — e.g. processes such as **erosion**, **weathering**, **transportation** and **deposition** (see pages 40-41) can move sediment **within** the system (e.g. from beach to dune).
4) **STORES/COMPONENTS** — **landforms** such as **beaches**, **dunes** and **spits** (see p. 42-44) are stores of sediment.

Events such as storm surges give high energy inputs — this can increase sediment inputs or outputs.

Coastal systems are generally in **dynamic equilibrium** — inputs and outputs are **balanced**. A **change** in one input or output often causes **negative feedbacks** that **restore** the balance of the system:

A **NEGATIVE FEEDBACK** is when a change in the system causes other changes that have the **opposite effect**. For example, as a beach is **eroded**, the cliffs behind it are exposed to **wave attack**. Sediment eroded from the cliffs is **deposited** on the beach, causing it to **grow in size** again.

Coastal systems also experience **positive feedbacks** that change the balance of the system, creating a **new equilibrium**:

A **POSITIVE FEEDBACK** is when a change in the system causes other changes that have a **similar effect**. For example, as a beach starts to **form** it slows down waves, which can cause more sediment to be **deposited**, increasing the **size** of the beach. The **new** equilibrium is reached when **long-term growth** of the beach **stops**.

There Are Lots of Sources of Energy in Coastal Systems

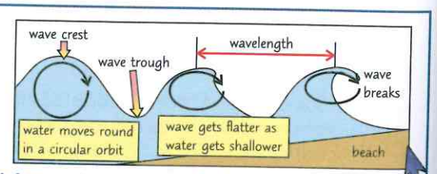
In the coastal system, energy is **transferred** by **air** (as wind) and by **water** (as waves, tides and currents):

Wind

1) **Winds** are created by air moving from areas of **high** pressure to areas of **low** pressure. During events such as **storms**, the pressure gradient (the difference between high and low pressure) is high and winds can be very **strong**.
2) Strong winds can generate **powerful waves**. In some areas, wind consistently blows from the **same** direction (this is called a **prevailing wind**) — this causes **higher-energy waves** than winds that change direction frequently.

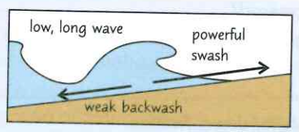
Waves

1) **Waves** are created by the **wind** blowing over the surface of the sea. The **friction** between the wind and the surface of the sea gives the water a **circular motion**.

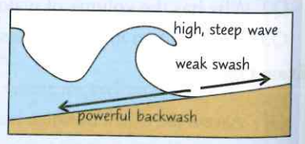


2) The **effect of a wave** on the **shore** depends on its **height**. Wave height is affected by the **wind speed** and the **fetch** of the wave. The fetch is the **maximum distance of sea** the wind has blown over in creating the waves. A **high wind speed** and a **long fetch** create **higher** and more **powerful** waves.
3) As waves approach the shore they **break**. **Friction** with the sea bed **slows** the bottom of the waves and makes their motion more elliptical (squashed and oval-shaped). The **crest** of the wave rises up and then **collapses**.
4) Water washing **up** the beach is called the **swash**. Water washing **back** towards the sea is called the **backwash**.
5) There are **two types** of wave:

Constructive waves have a **low frequency** (only around **6-8** waves per minute). They're **low** and **long**, which gives them a more **elliptical** cross profile. The powerful swash carries material up the beach and **deposits** it.



Destructive waves are **high** and **steep**, with a more **circular** cross profile. They have a **higher frequency** (**10-14** waves a minute). The strong backwash **removes** material from the beach.



Wave frequency is how many waves pass a point in a particular time.

6) The waves in an area are usually **mainly constructive** or **mainly destructive**.

The Coastal System

Tides

1) Tides are the periodic **rise** and **fall** of the **ocean surface**, caused by the gravitational pull of the **Moon** and the **Sun**.
2) Tides affect the **position** at which **waves break** on the beach (at high tide they break higher up the shore). The area of land between **maximum high tide** and **minimum low tide** is where most landforms are created and destroyed.

Currents

1) A **current** is the general flow of water in one direction — it can be caused by **wind** or by variations in water **temperature** and **salinity**.
2) Currents move material **along** the coast.

Currants — check. Salinity — check. Karen knew how to make her cake memorable.

Coasts can be High Energy or Low Energy

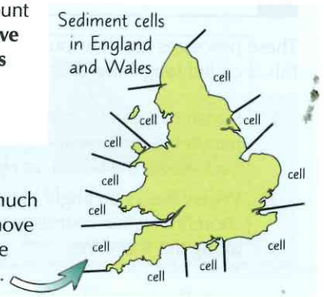
1) **High-energy** coasts receive high inputs of energy in the form of **large**, **powerful waves**. These can be caused by **strong winds**, **long fetches** and **steeply shelving** offshore zones. High-energy coastlines tend to have **sandy** coves and **rocky** landforms, e.g. cliffs, caves, stacks and arches (see p. 42). The rate of **erosion** is often **higher** than the rate of **deposition**.
2) **Low-energy** coasts receive low inputs of energy in the form of **small**, **gentle waves**. These can be caused by **gentle winds** (e.g. if the location is **sheltered**), **short fetches** and **gently sloping** offshore zones. Some coastlines are low energy because there is a **reef** or **island** offshore, which protects the coast from the full power of waves. Low-energy coastlines often have **saltmarshes** and **tidal mudflats**. The rate of **deposition** is often **higher** than the rate of **erosion**.

There Are Lots of Sediment Sources in Coastal Systems

1) There are lots of **inputs** of sediment into the coastal system:

- **Rivers** carry eroded sediment into the coastal system from **inland**.
- **Sea level rise** can flood river valleys, forming **estuaries**. Sediment in the estuary becomes part of the coastal system.
- Sediment is **eroded** from **cliffs** by waves, weathering and landslides.
- Sediment can be **formed** from the crushed **shells** of marine organisms.
- Waves, tides and currents can transport sediment into the coastal zone from **offshore deposits** (e.g. sandbanks).

2) The **difference** between the amount of sediment that enters the system and the amount that leaves is the **sediment budget**. If **more** sediment **enters** than leaves, it's a **positive sediment budget** and overall the coastline **builds** outwards. If **more** sediment **leaves** than enters, it's a **negative sediment budget** and overall the coastline **retreats**.



Sediment Cells

- The coast is divided into **sediment cells** (also called **littoral cells**).
- These are lengths of coastline (often between two headlands) that are pretty much entirely **self-contained** for the movement of sediment (i.e. sediment doesn't move between cells). This means that **processes** going on in **one cell** don't affect the movement of sediment in **another** cell — each cell is a **closed coastal system**.

Practice Questions

Q1 Draw a table to show the main inputs, flows, outputs and stores of a coastal system.
Q2 Describe the differences between high-energy and low-energy coasts.

Exam Questions

Q1 Outline the characteristics of constructive waves. [4 marks]
Q2 Outline the sources of energy in a coastal system. [4 marks]

What did the sea say to the beach — nothing, it just waved...

Lots of technical terms on these pages, but it's worth learning them — they'll really help you understand the rest of this topic. So make sure it's all as familiar as your favourite pair of socks (you know the ones — with the holes and the sausage-dog print).