GeoActive Online 356

INVESTIGATING COASTAL PROCESSES FOR GCSE COURSEWORK

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COASTAL ENVIRONMENTS are full of geography and make a good location for GCSE coursework. This unit explains how a number of practical fieldwork techniques can be used to investigate the way that waves arrive on a beach and the effect they have on its shape and the material that makes it. A number of different coursework titles could be investigated on the same beach using these techniques. It is a good idea to work with other pupils to share the collection of fieldwork data before working on different investigations which use the information.

Investigation plan

1 Choose a beach location. A pebble beach will give a wider range of titles but sandy beaches are fine. Check for the times of high and low tides – at all times make sure it is safe to study on the beach.

2 Decide on a coursework title. Waves often act on beaches to move sediment from one location to another by the process of longshore drift. Your title should focus on linking observations about the wave conditions of a beach to findings about the shape of the beach or the position of pebbles on the beach.

Possible titles could be in the form of a **hypothesis**, which is a statement to be proved or disproved, for example:

- Swash and backwash sort beach pebbles by dragging smaller pebbles to the bottom of beach X.
- Longshore drift makes the beach wider at one end of beach X.
- Smaller pebbles are carried further by longshore drift on beach X.

Alternatively, coursework can be addressed as a question, for example:

- In which direction and how fast is longshore drift occurring on beach X?
- Is beach X a result of the work of constructive or destructive waves?
- How are pebble sizes related to their position on beach X?

3 Decide in advance which fieldwork techniques you need in order to answer your hypothesis or question. Also decide who you will work with to collect the data.

4 Ask a teacher to help you to carry out a full risk assessment for your fieldwork to avoid dangers like incoming tides, slippery rocks, cliffs, large waves, etc.

Beaufort force	Windspeed (knots)	Sea condition	On land
0	0	Sea like a mirror	No wind
1	1–3	Ripples but no foam crests	Wind cannot be felt
2	4–6	Small wavelets; crests do not break	Wind felt on face, leaves rustle, vanes begin to move
3	7–10	Large wavelets; some break white	Leaves and small twigs constantly moving
4	11–16	Small waves; frequently break white	Dust, leaves and litter blow about, small tree branches move
5	17–21	Moderate waves, many break white	Small trees begin to sway
6	22–27	Large waves begin to form, probably spray	Larger tree branches moving
7–8	28–40	Very large waves; white foam blown in streaks by the wind	Whole trees moving, walking against wind difficult
9–12	41–64	High waves; crests of waves roll over, sea looks white; spray affects visibility	Trees and houses damaged

Figure 1: **Beaufort wind scale**

5 Collect data from fieldwork (**primary data**) and search for published information to support the project such as maps, textbooks and the internet (**secondary data** – Figure 1, for example).

6 Present your findings using graphs, maps, tables, annotated photographs and even statistics.

7 Analyse your findings and draw conclusions which answer the hypothesis/question.

8 Discuss the limitations of your project and how you could improve it if you were to repeat it.

Fieldwork techniques

Establishing the wave conditions

In order to explain any findings about the beach you will need to survey the way in which the sea

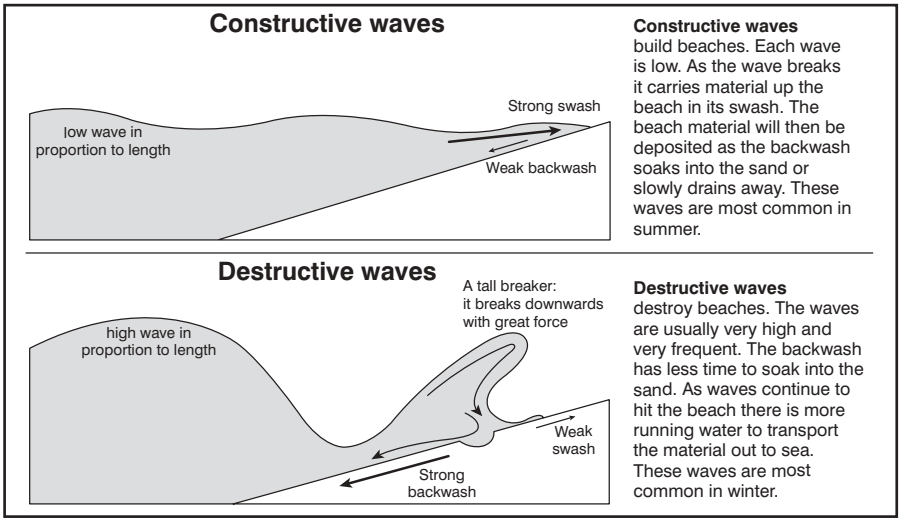


Figure 2: **Wave types**

interacts with the beach at a location. Here, seven techniques are described. You could use these to help your work in answering the coursework hypothesis or question.

1 Prevailing wind and waves

Using a map and compass, find out which direction the beach faces and the direction of the incoming wind and waves. If possible use a hand-held anemometer to record the wind strength. Alternatively estimate it using the Beaufort wind scale (Figure 1). Record the direction and strength of the wind and wave direction three or four times during the day to see if this varies. Search the internet for weather station records near your beach to give a longer-term picture.

2 Fetch

Using a map or atlas and the wind direction, work out the **fetch**. This is the distance to the nearest land across the water and is the maximum distance over which waves can form before hitting the beach. The length of fetch and strength of the wind determine the size of waves on the beach.

3 Wave types

Waves can either be constructive or destructive, as shown in Figure 2. Both types are responsible for changing the shape and structure of the beach and it is important that you find out which types are occurring on the beach. Watch a few waves and see which image they most appear like. Both types may occur on the same beach, so calculate the **wave frequency** to check.

4 Wave frequency

Count the number of breaking waves in 5 minutes and calculate an average. More than 13 per minute is, overall, destructive while less than 13 is constructive. Check this by counting the seconds between the waves (called the **wave period**). Constructive waves are usually 9–10 seconds apart but destructive waves are more likely to be 4–5 seconds apart. Repeat these tests several times in the day to see if this varies.

5 Longshore drift

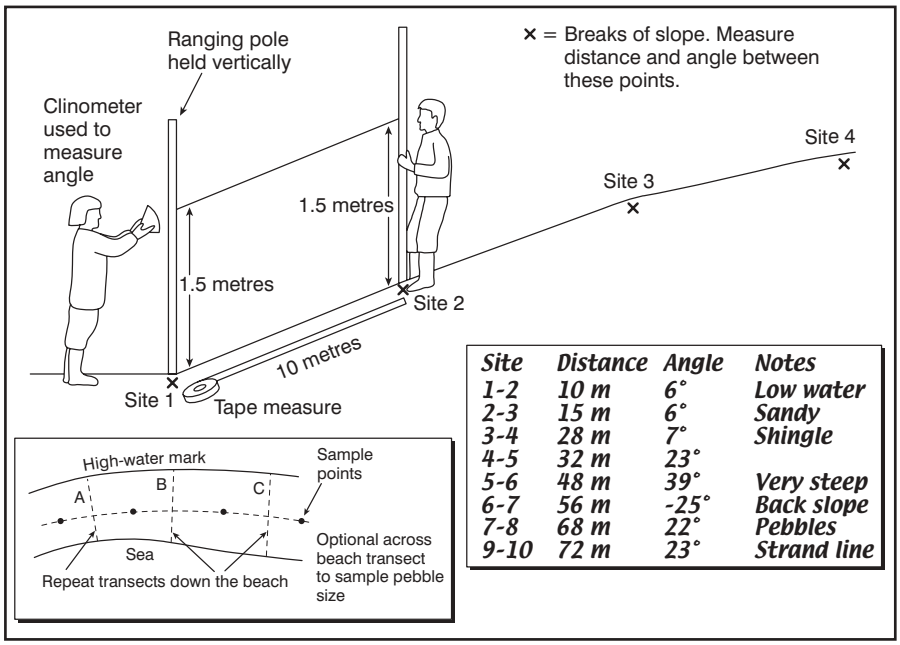
If the waves are hitting the beach head-on (at right-angles to the shore) they will move material up and down the beach. However, if they hit it at an angle they may move material along the beach by a process called longshore drift. You can test for this.

(a) Before going to the coast collect around 20 pebbles of various sizes. Paint the pebbles with a bright waterproof paint.

(b) Place the pebbles in the swash zone of the beach, clear of any obstructions. Mark their starting point using a ranging pole.

(c) Record the time and start counting waves. After 50 waves record the time and find as many of the pebbles as you can. Record the direction of movement and measure the distance they have travelled. Hopefully you will be able to find enough pebbles to work out the direction of longshore drift. To calculate the speed of longshore drift, divide the average distance the pebbles have travelled by the time taken.

This method only tests longshore drift at one moment in time. Consider repeating the experiment again later in the day or even on another occasion if time allows.



Site	Distance	Angle	Notes
1-2	10 m	6°	Low water
2-3	15 m	6°	Sandy
3-4	28 m	7°	Shingle
4-5	32 m	23°	
5-6	48 m	39°	Very steep
6-7	56 m	-25°	Back slope
7-8	68 m	22°	Pebbles
9-10	72 m	23°	Strand line

Figure 3: **Taking a beach profile**

6 Beach shape

Drawing a cross-section of the beach is a very useful technique to look at the impact of waves on the beach. Beaches adopt different shapes for constructive and destructive waves, and may have features related to pebble size or show the effect of longshore drift.

Equipment needed:

- Two ranging poles
- Long tape measure (at least 20 metres)
- A clinometer

– and at least two people.

To produce a beach profile like the one in Figure 3, use the equipment in the following way.

(a) Lay one end of the tape measure at the water's edge and unwind it up the beach to make a transect line.

(b) One person stays at the water's edge and places a ranging pole at the start of the tape measure. The second person walks up the beach to the first point where the beach slope appears to change, and records the distance. If there is no obvious change of slope then they should stop at 10 m. They then put their ranging pole on the tape measure.

(c) Person 1 holds the clinometer at the 1.5 m height mark on their ranging pole and looks along it to the second point at 1.5 m, and reads off the angle.

(d) Person 2 now stays in place and person 1 takes their ranging pole further up the beach until the next change of slope, recording the distance. Person 2 now uses the clinometer to read the angle.

(e) Repeat the whole process, leap-frogging up the beach.

Once you have plotted your results you should be able to label features on the beach and decide what type you think it is, according to Figure 4.

If you are investigating the movement of material along the beach by longshore drift you will need to do more than one profile. Pace 100 big steps (100 m) down the beach in the direction you think longshore drift is occurring and repeat the process. The beach should be wider and/or higher in the direction of longshore drift. Up to this point all fieldwork could be carried out on any beach. However, if your beach includes pebbles you could investigate a subject based on the size of pebbles and where they occur on the beach.

Figure 4: **Beach shapes**

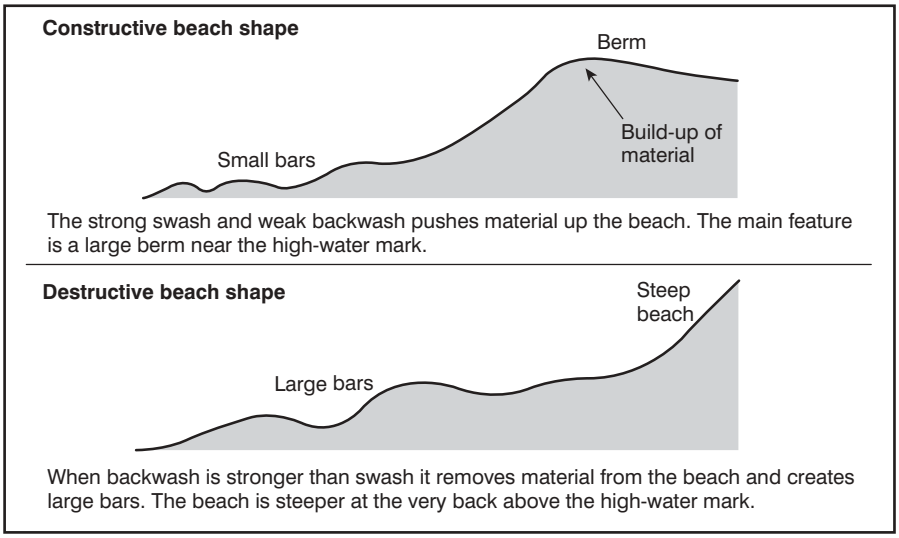
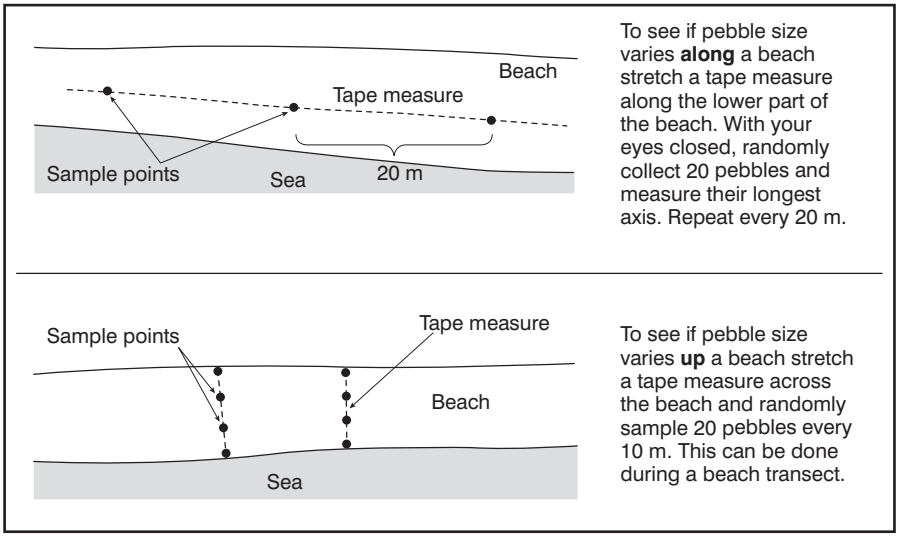


Figure 5: **Pebble sampling**



7 Pebble size

Smaller and lighter pebbles are carried more easily by waves than large heavy pebbles. As a result smaller pebbles are often carried further by longshore drift, or sorted up and down the beach by wave action.

To investigate either of these processes, use a tape measure to randomly select and record the length of pebbles at equal intervals, as described in Figure 5.

Conclusion

Careful use of appropriate techniques can lead to a wealth of data for a coursework title. This data then needs to be presented clearly and analysed carefully to draw conclusions in order to answer the original question or hypothesis. Do not worry if you did not get the answer you expected – just try to explain what you did expect and why you think your data differs. Go on to evaluate all the techniques you used and make a list of their limitations. You could also offer suggestions for how the methods could be improved if the coursework was to be repeated.

Activities

1 There are a number of words in this unit which should be used appropriately in coursework and examinations.
(a) What is *fetch*?
(b) Draw a diagram to explain the process of longshore drift. Include the labels:
- *swash*
- *backwash*
- *direction of longshore drift*.

2 Coursework usually involves collecting and using both primary and secondary data.
(a) What is the difference between *primary data* and *secondary data*?
(b) Give two examples of each type that you might use in your coursework.
(c) What limitations might secondary data have?

Use the data in Figure 6 to answer activities 3–6.

3 (a) Calculate the average wave frequency. What wave type does this indicate?
(b) Draw the beach profile for location A and label key features. Does this profile match up with your results from (a)?

4 If the beach faces south, in which direction is longshore drift, given the wind and wave direction?

5 Draw and label all three beach profiles on graph paper. Is there any evidence for longshore drift down the beach?

6 Plot bar graphs for the pebble data and compare them with your profiles. Do they support your findings so far? For extra clarity look at mode pebble size for each site.

7 The data in Figure 7 was collected by another pupil who is investigating longshore drift.
(a) Plot the data on a scattergraph. Comment on any relationship you find. In which direction is longshore drift?

Point	Location A (west) Distance (m)	Angle (°)	Location B (middle) Distance (m)	Angle (°)	Location C (east) Distance (m)	Angle (°)
1	10	14	12.5	20	11	25
2	18	20	22.4	8	20	10
3	20	11	30.0	26	30	–6
4	25	5	35.0	–3	35	26
5	30	21	43.0	13	45	30
6	40	–4	–	–	–	–

Pebble categories	5–10 mm	11–50 mm	51–70 mm	>70 mm
Pebble frequency				
Location A	0	3	7	10
Location B	2	4	13	1
Location C	5	12	3	0

Recordings	1	2	3	4	5
Wave direction	SW	SW	SW	SW	SW
Wind direction	SW	SW	SW	SW	SW
Wind speed (km/h)	9	8	8	9	9

Readings	Waves per minute
1	7
2	8
3	7
4	9
5	6
6	8
7	7
8	10
9	8
10	6

Figure 6: **Data collected by pupils on a south-facing beach**

(b) Test this further with a Spearman Rank Correlation statistical test.

Extension activity
Use all the data from the activities above to write an analysis, conclusion and evaluation for the question: 'What evidence exists for the process of longshore drift occurring on this beach?'

Distance across beach (m)	Average pebble size (cm)
0	12.0
1	12.2
2	13.0
3	14.5
4	16.0
5	13.0
6	10.3
7	9.9
8	11.0
9	8.0
10	10.8
11	9.8
12	10.0
13	8.3

Figure 7: **Average pebble size for 13 sample points along the beach from west to east**

