

Coastline Protection

Coastline Protection uses the imaginative context of an eroding coastline and its effect on the community to engage and motivate pupils to investigate the most suitable mixture of sand, stones and cement for making concrete blocks for a protective sea wall.

The teachers notes and age appropriate pupil sheets exemplify a range of strategies which overcome potential barriers to learning and facilitate access to the practical activities and science concepts for a range of pupils with diverse learning needs.

What the pupils do

- Experience the multi-sensory context using 3 dimensional models, photographs, sound effects and role play
- Choose different mixtures of sand, stones and cement to make concrete blocks.
- Test the strength of the concrete blocks
- Recommend the best mixture for making concrete blocks for a sea wall.

Resources and advanced preparation

context 1 - the model

2 trays or plastic transparent tanks (approx size 30 x 20 cm), 1 kg clay, 6 small stones, sand (about 500 g), 2 model houses, match sticks to represent fence posts, twigs for trees
N.B. The model needs to be left overnight

context 2 - the photographs

pupil sheet 1

context 3 - the script and sound effects

pupil sheet 2, *BBC Essential Sound Effects* CD 792, Seagulls over cliff

Making the concrete - each group requires:

talcum powder (small sample to feel), concrete building block or other sample of concrete, pupil sheets 3 (cut into cards), 4, 5 and 6 (cut into cards), newspaper/polythene sheet, disposable gloves, safety goggles, fine gravel/stones used for fish tanks (about 500 g), cement (about 200 g), sandpit sand (about 500 g), 4 disposable cups or yoghurt pots, 4 old tea spoons, 1 dessertspoon, identical moulds from sweet or small cake packaging for example Mr Kipling

N.B. There needs to be a week between making and testing the concrete.

Testing the concrete - each group requires:

pupil sheet 7, soft ball, decimetre ruler (a metre ruler can be divided into 10 equal divisions of 10 cm intervals by covering the original scale with coloured paper bands), small transparent food bags and ties

Setting the context



Fig.1 Model coastline

Choose the method which best uses all the pupils' available senses to set the context.

Context 1 uses 2 identical models (see Fig.1) of a coastline assembled with the pupils. Make a model cliff by packing clay, sand and stones into the corner of a transparent tank. Place the model house and twig 'trees' on the edge of the 'cliff' and push half matchsticks into the clay at 1 cm intervals to represent a fence.

Pour water slowly into one tank and agitate it by hand to simulate waves. Leave the second model coastline dry as a control.

The sand visibly washes away but firm clay will be seen to resist wave action. If the models are left overnight, pupils will see that the waterlogged clay begins to collapse and a comparison with the dry 'cliff' can easily be made.

The model maximises visual and kinaesthetic strengths. It provides a focus for asking questions and lasts throughout the lesson, bringing the pupil back on task if their concentration wanes. If the pupil builds the model, it gives them a sense of ownership of the activity.

Context 2 uses the newspaper photographs. Ask the pupils to compare the photographs of the Holbeck Hall Hotel on the South Cliff in Scarborough before and after the landslip in 1993. Focus their attention on comparing the number of distinctive gable ends in each photograph.

The photographs maximise visual strengths and the short sentences, using simple vocabulary and a large font size, support literacy.

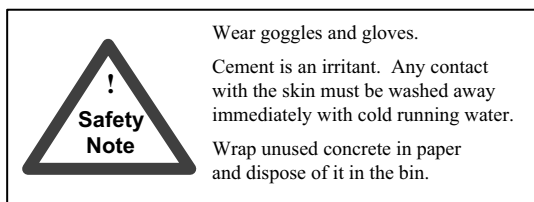
Context 3 uses the script and sound effects. An overnight storm brings down the cliff, including part of Mrs Green's fence. Assign speech or acting parts to the pupils and let them read through or act out the script. The sound of seagulls over a cliff can be played in the background.

The script maximises auditory strengths and if acted, kinaesthetic strengths. The role play introduces a personal element to setting the scene.

Making the concrete samples

Tell the pupils that they are going to build a sea wall out of a strong material called concrete.

Pupil sheet 3 *Facts about concrete* should be cut into cards. Ask the pupils to match the written text to the illustrative pictures by sticking the paired cards onto pupil sheet 4. The illustrations support the written text and pairing the cards helps short term memory.



Tell the pupils to look at and feel a piece of concrete alongside its components. The sand, stones and cement should be labelled clearly to support literacy. Talc can be felt in the place of cement to demonstrate a similar texture.

Tell the pupils that mixing different amounts of sand, stones and cement will make concrete with different properties. They may be familiar with mixing concrete using shovelfuls in a concrete mixer. Recipes for concrete are measured in volumes or parts using spoonfuls or cupfuls and bypass the need for standard measures or the ability to count above 5.

Explain that they are going to investigate the effect of changing the number of spoonfuls of cement on the strength of different concrete samples.

Ask the pupils: *Which amount of cement will make the strongest concrete?*

Use disposable cups and spoons to mix the concrete. Prepare and label identical moulds in readiness for the chosen concrete mixtures.

Mixtures pupils could try, to investigate the effect of changing the amount of cement, are:

spoons of	cement	stones	sand
A	0	4	4
B	0.5	4	4
C	1	4	4
D	2	4	4

Pupils may use pupil sheet 4 to record their choices on the same table as their results. (Actual samples of the three materials may be stuck in the table instead of the words and illustrations for those pupils who do not use written text.) One pupil may use the table to plan four mixtures or to record their own and three other pupils' mixtures as a group activity. This flexibility allows the pupil to contribute to a complete set of results, at their own pace, in the time available.

Pupils' understanding of an unfair test precedes that of a fair test. Demonstrate in an exaggerated way the following examples of unfair tests:

- put 4 spoonfuls of stones in one cup and only 1 spoonful in another
- count 4 spoonfuls of sand into a cup using a teaspoon and a dessertspoon alternatively.

In each example ask the pupils: *Is this fair?*

If changing the quantity of cement alone is to be compared, then the quantities of sand and stones need to be kept the same in each of the concrete samples, or the comparison in the test just isn't fair.

Pupils may demonstrate their understanding on pupil sheet 5.

Ask the pupils to make a thoughtful guess, that is, predict, which mixture (or quantity of cement) will make the strongest concrete. Ask individuals to give reasons for their predictions.

The prediction may be recorded on pupil sheet 5. Appropriate questions help the pupil to reason and a space indicates an achievable amount of written text for the response.

The instructions on pupil sheet 6, cut into cards, are in the form of text to be completed or realistic pictures for those who find written language difficult. The instructions may be read independently or with the teacher. By sequencing the instructions in words or pictures each pupil may demonstrate their understanding and work independently. The cards can also be sequenced or paired at a later date to reinforce the procedure and assist memory.

Water should be added *sparingly*, a spoonful at a time, to each mixture until a stiff paste is produced. The moulds should be filled to the same depth with their respective samples of concrete and any surplus should be disposed of.

The concrete samples need to be left for a week to harden.

Testing the concrete samples

Pupils test the strength of their concrete samples by dropping them from increasing heights until the sample breaks.

Demonstrate, in an exaggerated way, dropping and then throwing a soft ball (to represent the concrete sample) from a height of 1 m.

Ask the pupils: *Is this fair?*

If the test is to be fair, then the samples need to be dropped in the same way.

Safety – if large concrete samples have been made, the teacher should make sure that pupils do not drop the blocks near their feet. The teacher may choose to demonstrate the best (and fairest) way to drop the concrete samples.

Standing the ruler on the floor enables seated pupils to test their own samples independently. Enclosing each sample in a small, transparent food bag helps to isolate and contain broken fragments of concrete as the samples break. The bags plus contents can be used later to display the results.

The results may be recorded in the table on pupil sheet 5.

A wall display linear graph may be assembled by hanging the actual bags of concrete, as each sample breaks, alongside a ruler from the height at which the sample broke (see Fig. 2). By dropping the samples in the order of nil to greatest amount of cement content, a linear pattern can be seen emerging. This procedure omits the need to record the results initially in a table and helps the slower working pupil to see a pattern in their results more immediately.



Fig.2 Concrete samples become the points of the graph

The results may alternatively be displayed on pupil sheet 7. The graph axes and appropriate scale of paper help the slower worker to organise a limited number of results independently. Numbers of spoonfuls are filled in and the heights at which the samples break are recorded on the graph.

The strongest sample is identified and related to the amount of cement in the mixture. (Using the mixtures suggested in the table, pupils should find the strongest sample will be the one containing the most cement.)

Encourage pupils to compare the results with their original prediction.

Show the pupils the photograph on pupil sheet 8 of a concrete sea wall. The familiar image of a boy fishing gives the unfamiliar sea wall a sense of scale. This photographic evidence that sea walls are made of concrete gives the investigation and the pupils' results worth and meaning.

The activity may be concluded by making enough small concrete blocks of the strongest mixture to build a wall that can be added to the model context setter. Repeat the introductory activity to test the effectiveness of the sea wall.

Extension of the activities

1. Test the effect of changing the amount of stones on the strength of the concrete by keeping the amount of cement to 1 part and the amount of sand to 4 parts and making mixtures with 1 to 4 parts of stones.
2. Test the effect of changing the amount of sand by keeping the amount of cement to 1 part and the amount of stones to 4 parts and making mixtures with 1 to 4 parts of sand.

What do teachers say about the activity?

Teacher of pupils with moderate learning difficulties

Despite reading difficulties, our pupils coped well. The pupil sheets did not have too much text and were very pictorial, which helped.

Teacher of the hearing impaired

The pupils could read the text independently. I was surprised by how much they were able to contribute to the planning and carrying out a fair test.

Teacher of pupils with autism/severe learning difficulties

The activity was highly motivating. The pupils responded with sustained interest.

The hands-on multi-sensory activities are much appreciated as they do not depend on written language and use the pupils' visual strengths.

Teacher of the visually impaired

They enjoyed the sound of the breaking concrete. They had a good feel of the results and counted the pieces of broken concrete in the mould.

Coastline Protection Experimental and Investigative Science Performance Indicators

Learning objective	Level 1	Level 2	Level 3	Level 4
Planning	with guidance, communicates what they think might happen to the cement, sand and stones when water is added.	with help chooses a mixture for making concrete communicates what might happen to each concrete sample when it is dropped.	with help communicates fair testing in any of these ways: keeping the amount of sand and/or stones the same using the same sized mould for each concrete sample predicts which concrete sample will be the strongest	carries out a fair test independently suggests and selects their own equipment predicts which concrete sample will be the strongest
Obtaining evidence	uses their senses to experience a change in the concrete when it hardens experiences mixing concrete experiences dropping the concrete samples	counts spoonfuls experiences mixing concrete measures the height of the drop experiences dropping the concrete samples communicates/records what happens	follows instructions to mix concrete and test the samples fills in results table on pupil sheet 5 independently	makes concrete samples with different mixes and tests them designs own table to record results using a suitable range of measurements
Considering evidence	communicates that the concrete is hard or that it breaks when dropped (these observations are not linked as a comparison)	helps construct a wall display graph compares concrete samples comments if they thought this would happen	constructs a block graph using pupil sheet 7 communicates that the concrete with the greatest amount of cement is the strongest	draws a line graph with help communicates that the strength of the concrete increases as the amount of cement added increases (The cement forms crystals when water is added which hold the sand and cement together)