Innocent until proven guilty
Using forensic geoscience to solve the crime

To the teachers:
The crime that is being investigated is the smuggling of people from abroad. They travelled through three different places, in the north, middle and south of the country, and each place has distinctive sand, mineral or soil particles which can be used as forensic geoscience evidence.

Place in country	Specimen
North	A - red sand
Middle	B - soil
South	C - beach sand

Three containers of sediment specimens, as suggested in the table above, will be needed. The sediment grains should be easy to see. Some particles of each sample could be glued on to three microscope slides or put into three clear specimen bags.

In this activity there are four suspects from whom forensic geoscience evidence has been obtained, as shown in the tables below. Tell the pupils that the samples have been taken from their clothes or shoes.

Suspect 1	Suspect 2
red sand	beach sand
soil	
beach sand	

Suspect 3	Suspect 4
chalk dust	black sand

- Label a small container* **Suspect 1** and sprinkle into it a tiny amount of a mixture of the 3 specimens, A, B and C;
- Label a second container **Suspect 2** and sprinkle into it some of Specimen C. Completely different material could be added to increase complexity;
- Repeat the same procedure with chalk dust for **Suspect 3** and black sand for **Suspect 4**. Again other material could be used, but make sure it is completely different from Specimens A, B and C.

* *microscope slides and clear glue can be used*

Ask the pupils:
- to use a magnifying glass, hand lens or micro-scope, to study specimens A, B and C very carefully.
- to read the information provided about the crime, as in the box opposite. The activity is more interesting if this information is written as a newspaper report:-

Pupils from Stonar School www.stonarschool.com investigating the forensic evidence *Photo: Elizabeth Devon*

People smuggling
- people smugglers entered the country in the north (specimen A),
- one of the people being smuggled became ill and died,
- the victim's body was found in the middle of the country (specimen B),
- a white van believed to be involved in the crime was found abandoned in the south of the country,
- four suspects are being interviewed by police and forensic evidence gathered from them.

Report on the white van found abandoned at the location in the south of the country:-
- red sand and soil were found embedded in the tyres. These have been confirmed as being identical to specimens A and B, indicating that the vehicle had been to the north of the country, where the people smugglers entered, and that it had been to the middle of the country where the body was found,
- the tyre tread pattern matched tread patterns found at both locations,
- fibres inside the van matched those from the blanket used to wrap the body.

Give the pupils copies of the police interviews with the four suspects. (Some ideas are given in the box on page 2). *It is fun to make up names for these people and use amusing photographs. Make your own guilty-looking faces - www.morphases.com*

The activity is enjoyed most by the pupils when rôle plays are used with different people reading the parts of the police and of the suspects; different accents are to be encouraged! Remember that other forensic evidence can be added like fingerprints or DNA samples.

POLICE INTERVIEWS WITH FOUR SUSPECTS

Suspect 1: He is very loud and confident saying that on the days in question he was in X, e.g. London. He has never heard of the places in the north or middle of the country and has visited the seaside resort in the south once when he was a boy. When faced with the geoscience evidence against him, he says the police are trying to frame him.

Suspect 2: She is very nervous and says she does not know anything. She comes from the middle of the country and does not know how she got beach sand on her shoes. She says she was at work at the time of the crime, although her boss says that she 'phoned in to say she was sick.

Suspect 3: She is unwilling to talk to the police and does have a criminal record for handling stolen goods. The chalk dust found in her clothes comes from near where she lives. She collected her children from school on each day when the crime could have taken place.

Suspect 4: He is very annoyed at being interviewed by the police, having just returned from Hawaii; this explains the traces of black sand found on his clothes. He threatens to write to his member of Parliament about being questioned by the police and not even being given a cup of tea at the police station.

Now ask the pupils to study the samples from the suspects very carefully and to draw some conclusions.

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The back up:

Title: Innocent until proven guilty

Subtitle: Using forensic geoscience to solve the crime

Topic: This activity can be included in any lesson where problem-solving skills are required. It is adaptable to local conditions - local samples of soil, sand or rocks can be used. Also local suspects e.g. the teacher, can be used!

Age range of the pupils: 10 - 14 years

Time needed to complete the activity: 30 minutes depending on ability

Pupil learning outcomes: Pupils can:
- develop their problem-solving skills;
- realise that a negative result eliminating someone or something is as valuable as a positive result;
- look carefully at the evidence and decide what is needed to prove something true or false;
- realise that people who look guilty are not always involved in the crime and people who have a criminal record might be innocent.

Context:
After having looked at all the samples very carefully the pupils should be able to work out which suspect is most likely to have been involved in the crime.

Suspect 1 had visited all three places involved in the crime. However, this is not proof of his guilt but only gives substantial evidence towards his guilt. He lied in his interview claiming never to have been to any of these places.

Suspect 2 can only be linked to the crime by the beach sand from the place in the south but this alone does not prove anything. However, police have discovered that she knows Suspect 1 and may well have been persuaded to help him. She may or may not know about the body. She could be further implicated by other forensic evidence, or not, as is appropriate for the pupils.

Suspect 3 Despite her previous criminal record, there is no evidence to link her to this crime.

Suspect 4 He is not involved in this crime and was indeed holidaying in Hawaii when it took place.

Following up the activity:
- pupils could think of their own crime scene using local materials and, maybe, local suspects;
- the number of places and specimens can be varied according to the complexity required.
- techniques used to identify geological materials in real crime scenes could be investigated, including optical microscopy, cathodoluminescence microscopy and scanning electron microscopy (SEM).

Underlying principles:
- Forensic geoscience uses evidence from geological material at the scene of a crime to support or defend against a prosecution in court.
- Forensic geoscience evidence alone does not prove someone's guilt.
- It is important to examine all the evidence very carefully before reaching conclusions.

- Criminals must be caught so it is very important to gather as much evidence as possible to be sure of guilt and subsequent conviction.

Thinking skill development:
- Putting all the evidence together involves pattern-seeking.
- Some samples do not match the evidence given by the suspects; cognitive conflict.
- Discussion of the samples' contents and evidence given by the suspects involves metacognition.
- Applying the evidence gained from the samples to convicting a criminal in a possible court case involves bridging.

Resource list
- containers for the specimens
- samples of red sand, soil, white chalk dust, black sand
- microscope slides or clear specimen bags
- glue that will be transparent when dry, for use on the microscope slides
- magnifying glasses, hand lenses or microscopes, whichever is available. The activity could be carried out without any of these if they are not available.

Useful links:
http://www.geolsoc.org.uk/gsl/groups/specialist/forensic
Earthlearningidea 'Dinosaur death: did it die or was it killed?'
http://www.earthlearningidea.com/English/Evolution_of_Life.html

Source: Developed by Elizabeth Devon, Earthlearningidea team, from an idea by Maggie and Peter Williams, Dept. of Earth and Ocean Sciences, University of Liverpool.

Example of Forensic Geoscience activity
Photo: Elizabeth Devon