# The city that rocks: Key planning considerations for teachers

<table>
<thead>
<tr>
<th>Knowledge</th>
<th>Acquire new knowledge</th>
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<tbody>
<tr>
<td>Linking knowledge</td>
<td></td>
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<tr>
<td>Apply existing knowledge to new situations</td>
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<tr>
<td>Build on existing knowledge</td>
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| Names of rocks |
| Types of rocks and the rock cycle |
| Source / Uses / Value of rocks |
| Age of buildings / Land use |

<table>
<thead>
<tr>
<th>Skills</th>
<th>Observation &amp; Description Interpretation &amp; Classification</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Measuring &amp; Recording</td>
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| How to observe rocks |
| How to classify / identify rocks |
| How to construct a relative scale |

<table>
<thead>
<tr>
<th>Attitudes</th>
<th>Rocks are relevant</th>
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<tbody>
<tr>
<td></td>
<td>Rocks and geology are interesting</td>
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</table>

| Demonstrate rocks in a familiar setting |
| Demonstrate practical application of geology |

## Physical properties

- Why are particular (types of) rocks used for certain purposes?
- How are rocks (building stones) affected by weathering / pollution / humans?

## Visual properties

- Are certain types of rocks considered more prestigious than others?
- How does the attractiveness of a rock affect its use?

## Supply

- Why are local rocks used for certain buildings?
- Is there a link between age / prestige of a building and where the rock came from?
- How do the rocks in a town centre represent the development of globalisation?

## Approach

- Gather data during trail & carry out research and investigations back at school to explain findings
- Introduce and investigate relevant themes before the trail, gather evidence for / against throughout the trail
- Give students a statement to investigate and allow them to plan their own approach
- To prove or disprove something / To explain why / To explain how / To gather evidence
- Also consider group size (small groups / whole class) and degree of direction / independence

## WHAT

<table>
<thead>
<tr>
<th>Shopping centre</th>
<th>Retail outlet</th>
<th>Kerbstones.</th>
<th>Church</th>
<th>Sculptures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office buildings</td>
<td>Public buildings</td>
<td>Pavement</td>
<td>Gravestones</td>
<td>Walls</td>
</tr>
<tr>
<td>Banks</td>
<td>Street furniture</td>
<td>Cobblestones</td>
<td>Monuments</td>
<td>Public Spaces</td>
</tr>
</tbody>
</table>

## WHY

- How does this help to achieve your aims?
- What should pupils have learnt / recorded / seen?

## TASKS

- Compare e.g. Level of detail on the protected side of the building to the exposed side
- Count e.g. How many different types of rock are used
- Find e.g. Something made of a sedimentary rock sandstone
- Record e.g. The building's construction date
- Classify e.g. The rock type used
- Rank e.g. How attractive the building stone is using a scale of attractiveness
- Identify e.g. The rock that the building is made from
- Describe e.g. How the rock feels
- Draw e.g. The rock's texture
- Measure e.g. The depth of the inscriptions on a monument

## RECORDING

- Tally e.g. To keep count of how many times you see a gravestone made from granite
- Table e.g. To record the visual properties of stones using a simple method
- Drawing e.g. To show the texture of a stone
- Description e.g. To record how the stone looks and feels
- Tick boxes e.g. To record the properties of stones used in a shopping centre from a set list
- Rubbings e.g. To show the degree of weathering on a monument
- Photos e.g. To show the staining on a building

## RESULTS

| Poster | e.g. photos, sketches and descriptions |
| Maps | e.g. source of rocks used in local buildings |
| Text | e.g. building stones pamphlet |
| Story Map | create online story to locate the rocks and |

| Bar chart | e.g. abundance of stone |
| Pie chart | e.g. rocks used for churches |
| Line graph | e.g. hardness against weathering |

## EQUIPMENT

- Building stone postcards
- Maps
- Magnifiers

- Phone/camera/ipad
- Crayons
- Rules

- Water dropper/spray
- Tracing paper
- (Tyre) depth gauges

## ACTIVITY

- Using building stones postcards to make a tool of reference
- Devising scales to measure / compare observations e.g. attractiveness / weathering / hardness
- Investigating hardness / porosity / reaction to acid of various stones/rocks
- Researching the costs / sources of different stones and how far they have been transported
- Researching how old certain buildings are

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The city that rocks: Influences on the use of rocks as building material

<table>
<thead>
<tr>
<th>PHYSICAL PROPERTIES</th>
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<tbody>
<tr>
<td><strong>Hardness</strong></td>
<td>Hard rocks will not wear down if used for paving or if placed somewhere exposed to the elements, such as granite cobbles</td>
</tr>
<tr>
<td><strong>Softness</strong></td>
<td>Softer rocks will be easier for masons and sculptors to carve</td>
</tr>
<tr>
<td><strong>Reaction to acid</strong></td>
<td>Rocks that react to acid will be more likely to deteriorate if exposed to the elements, e.g. limestone and marble reacting to acid rain</td>
</tr>
<tr>
<td><strong>Strength</strong></td>
<td>The strength (ability to withstand a weight-and/or impact) of a rock will be more important if the building is made of blocks of stone, but if the stone is just being used for facing, it will not be a consideration</td>
</tr>
<tr>
<td><strong>Porosity</strong></td>
<td>Porous rocks, such as many sandstones, into which water can soak easily are more likely to be affected by weathering and are more easily stained by pollution and soot that occurs in built up areas</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>VISUAL PROPERTIES</th>
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<tbody>
<tr>
<td><strong>Colour</strong></td>
<td>The colour or combination of colours will affect how attractive a stone is, and also may be considered so that the stone is compatible with its surroundings, such as green serpentine or pearly dark blue larvikite</td>
</tr>
<tr>
<td><strong>Texture</strong></td>
<td>The internal structure of the rock can affect its appearance and may make it more or less attractive, such as banding in gneiss and large interlocking crystals in granites</td>
</tr>
<tr>
<td><strong>Polish</strong></td>
<td>Whether or not a stone can be easily polished will affect its use as the textures and colours of stones are enhanced when they are polished</td>
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<table>
<thead>
<tr>
<th>SUPPLY</th>
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<tbody>
<tr>
<td><strong>Local stone</strong></td>
<td>Local stone doesn’t need to be transported very far, so many historic buildings such as churches, which were built before the development of canals and railways, are constructed of local stone</td>
</tr>
<tr>
<td><strong>Imported stone</strong></td>
<td>Most areas will only have one or two local types of stone, so it is not uncommon for stone to be imported from elsewhere in Britain or abroad</td>
</tr>
<tr>
<td><strong>Ease of extraction</strong></td>
<td>Whether or not the stone can be easily accessed and removed from a quarry will affect its abundance and cost</td>
</tr>
<tr>
<td><strong>Location of source</strong></td>
<td>The further a stone has to travel, the more it will cost.</td>
</tr>
<tr>
<td><strong>Cost of stone</strong></td>
<td>Building stones may be more expensive due to their rarity, attractiveness or difficulties associated with their extraction</td>
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</table>

The city that rocks: Descriptors for building stones (geo-vocabulary)

<table>
<thead>
<tr>
<th>DESCRIPTIONS</th>
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<tbody>
<tr>
<td><strong>Feel</strong></td>
<td>Rough Lumpy Smooth Jagged Glassy Sharp Sugary Coarse</td>
</tr>
<tr>
<td><strong>Colour</strong></td>
<td>Reddy brown Blue-brown Black Grey Red Pink Clear White Silver Green Blue Brown</td>
</tr>
<tr>
<td><strong>Type</strong></td>
<td>Natural stone Local Exotic Manufactured Polished / Raw From the area Purposefully brought in from elsewhere e.g. abroad Aggregates of crushed fragments</td>
</tr>
<tr>
<td><strong>Texture</strong></td>
<td>Grainy Crystals Layers Compactness Big grains / Medium grains / Small grains / Mixed grain size Big crystals / Medium crystals / Small crystals / Mixed crystal size Straight layers / Wavy layers / No layers Loosely cemented / Strongly cemented</td>
</tr>
<tr>
<td><strong>Condition / Weathering</strong></td>
<td>1 Fresh 2 Slightly weathered 3 Quite weathered 4 Weathered 5 Very Weathered No weathering Features slightly rounded but not much Features quite rounded Features have been very noticeably worn Features hardly distinguishable</td>
</tr>
<tr>
<td><strong>Beauty / Attractiveness</strong></td>
<td>1 Beautiful 2 Pretty 3 Nice 4 Normal 5 Unattractive Has lots of colours and shines / sparkles Lots of colours but doesn’t shine / sparkle Few colours but shines / sparkles Single colour and little shine / sparkle Single colour and dull</td>
</tr>
<tr>
<td><strong>Prestige / Use</strong></td>
<td>1 Prestigious 2 Important 3 Quite important 4 Not very important 5 Not at all important Banks, Building Societies, monuments Town halls, museums, libraries, cathedrals, universities Churches, schools High street shops Supermarkets, bargain shops, news agents, car parks, pavements</td>
</tr>
<tr>
<td><strong>Durability / Hardness</strong></td>
<td>1 Very Hard 2 Hard 3 Quite hard 4 Quite soft 5 Very soft Impossible to mark the rock by scratching it with a nail Difficult to mark the rock by scratching it with a nail Scratching the rock with a nail leaves a mark Scratching the rock with a copper penny leaves a mark Scratching the rock with your fingernail leaves a mark</td>
</tr>
</tbody>
</table>
Investigating local rocks. Collect examples of different types of rock from your local area (and from further away if you want to) and take your pupils through this investigation sequence - using the clues in the rocks to find out how they formed. Begin with two rocks, one made from sediment, a sedimentary rock, with obvious grains (eg. a sandstone) and the other, a crystalline igneous rock with big crystals (eg. a granite). Expected answers are shown in italics below.

Rock clues. Ask the pupils to work in groups of three. One should pick up one of the two rocks and describe it carefully to one of the others. The third person should try to remember key words and phrases used. Repeat this with the other rock – the third person remembers words and phrases used in both descriptions. These are then reported back to the rest of the class. This will identify key properties of rocks, namely: their colour, that they are made of ‘bits’, and that the surfaces feel rough.

Bit clues. Explain that the ‘bits’ are called grains. Then repeat this activity asking the pupils to describe some of the grains to each other. Common properties of the grains that they describe will be their: colour, shape, size and surface shininess (lustre).

Predicting properties. Ask the pupils to predict what will happen to the masses (weights) of the two rocks after they have been put into water. When they have agreed a prediction, they should watch very carefully as both rocks are put into water together and left for about a minute. They will clearly see bubbles of water rising from the sandstone, but many fewer from the granite. Ask for the sandstone: Where on the rock are most of the bubbles coming from? Why do they come from here? What does this tell you about the rock? Why is the sandstone different from the granite?

They should realise that: most of the bubbles rise from the top of the rock; they do this because the air in the spaces (pores) in the rock rises, allowing water to flow into the bottom; this shows that the rock is quite porous and that the spaces are connected (the rock is permeable). The granite has no connected spaces, so air and water cannot flow through.
Prediction test: They should have predicted that the sandstone would increase in mass because water would flow in, but the granite wouldn’t. In fact, the mass of the sandstone usually increases appreciably, while the granite may increase a small amount, because the surface becomes wet. If a balance is available, this can be tested.

Conclusion: the shape of the grains in sandstone means that there are spaces; the shape of the grains in the granite causes no spaces (rocks with spaces can hold water or other fluids, eg. oil/gas).

Comparisons. Use a piece of bread and a piece of metal as comparisons. Which rock is most like the bread? – the sandstone, since both have pore spaces. Which is most like the metal? – the granite, with no pore spaces. This can be shown by asking pupils to ‘weigh’ the bread and metal in their hands before and after dipping them into water.

Testing toughness. Ask pupils to predict what will happen when both rocks are scratched with a metal object. Then let them do it. They will find that it is easy to scrape grains off the sandstone, but much harder to scrape them off the granite. This test will distinguish most sedimentary rocks from most crystalline (igneous and metamorphic) rocks. Ask if their predictions were correct. The grains break off the sandstone easily because they are just stuck together by weak ‘glue’ (natural cement), but the grains in the granite and other crystalline rocks are interlocking – and much harder to break apart. This also explains why the sandstone was porous and the granite wasn’t.

Rock sort 1. Ask the pupils to use the tests above to sort the local rocks into two groups – the porous ones from which grains are easily broken off (sedimentary), and the non-porous ones with interlocking grains (crystalline igneous and metamorphic rocks).

Rock sort 2. They should sort examples of crystalline rocks into those with layers and those without. The layers in the layered crystalline rocks developed as the rock formed from other rocks under great pressure and often, high temperature (metamorphic rocks) - because of the high temperatures and pressures, the crystals interlock with no pore spaces. The non-layered rocks crystallised as liquid rock cooled down, with the crystals interlocking in random directions to form hard non-porous rocks with different crystal sizes.

Note: Two rocks that often cause problems are:
• limestone, that can look crystalline, but fossil clues show that it is sedimentary;
• slate, this can look like a layered sediment, but the grains are hard to scratch off, showing that it is crystalline.

Rock detective – the verdict. Local rocks:
• with spaces between the grains and grains that can easily be broken off, formed from ancient sediments – sedimentary rocks;
• that are non-porous, hard and have layers of interlocking crystals, formed from other rocks by high temperatures and pressures – metamorphic rocks;
• that are hard and non-porous with interlocking grains in random directions (and so have no layers), formed from liquid rock that cooled down – igneous rocks.

The back up
Title: Rock detective – rocky clues to the past.
Subtitle: Investigating your local rocks to find out how they formed.
Topic: Sorting rocks according to their properties, which depend upon how they were formed.
Age range of pupils: 10 – 16 years
Time needed to complete activity: 30 – 45 minutes

Pupil learning outcomes: Pupils can:
• describe rocks as being formed of grains that are arranged in different ways;
• investigate rocks for porosity and toughness, using water and a metal object;
• divide rocks into porous less tough sedimentary ones and non-porous, tough crystalline ones;
• subdivide crystalline rocks into crystalline layered rocks (metamorphic) and crystalline non-layered rocks (igneous);
• explain how sedimentary, igneous and metamorphic rocks formed.

Context: Pupils use the characteristic properties of a set of local rocks to sort them into sedimentary, igneous and metamorphic rock groups. This works reasonably well for most rocks, but there are exceptions, including:
• some sedimentary rocks are well-cemented with a tough cement and so are not porous or crumbly;
• some metamorphic rocks are not formed under pressure (but mainly by heat) and so have no layering;
• some metamorphic rocks contain only one mineral, and so banding or layering cannot be seen;
• some igneous rocks can be weakened by gas bubbles or weathering and so can be fairly crumbly
• some limestones can look crystalline, while slates can look sedimentary (see above).

Following up the activity:
• Ask pupils to sort out a wider selection of rocks, using the principles they have learned.
• Ask them to look for further clues in the rocks, on how they may have formed, eg.
  • sedimentary rocks may contain fossils or other sedimentary features ‘fossilised’ from the place where they were first laid down;
  • igneous rocks that have easily seen crystals = cooled slowly deep underground; those with crystals almost too small to see = cooled quickly from volcanic lavas at the surface;
  • metamorphic rocks with small grains have not been metamorphosed greatly; those with easily seen grains have been highly metamorphosed.

Underlying principles: These have been described as the story ‘unfolded’ above.

Thinking skill development: When pupils make predictions, they use their understanding to produce a mental model of what is likely to happen and why (construction). If this fails, they have to re-think (cognitive conflict). They can be asked to explain their thinking at these stages (metacognition). They should be able to apply what they have learned to new situations (bridging).

Resource list:
• A selection of local rocks, that should include a sandstone with obvious grains and a granite. If either or both of these are not available locally, they should be ‘imported’. It may be necessary to import other types of rock as well, to give variety. Each rock should be about the size of an adult big toe.
• A container (preferably transparent) of water.
• A metal object, eg. a knife, fork or spoon.
• Examples of: something porous, eg. a piece of bread; something non-porous, eg. a piece of metal.
• A balance, if available.

Useful links: ‘Spot that rock’ and the ‘ESEU virtual rock kit’ on the Earth Science Education Unit website: http://www.earthscienceeducation.com/

Source: This activity is based on a workshop devised by Duncan Hawley (Swansea University) and used as ‘Spot that rock’ by the Earth Science Education Unit.
Ematita from the high Andes in Argentina (Photo X and Y).

Underneath the side windows is a black, medium-grained igneous rock from South Africa, known as 'Bluestone' and about 750 million years old. Beneath the central windows is a popular igneous rock with intrusive black dolerite crystals known as 'Lavender' from Norway.

Furnace Court (ii) two doors away, is faced with an unusual coarse-grained granite with large rounded dolerite crystals. This is known as 'Ballycastle', from the Precambrian rocks of Fife, and is about 1000 million years old. Granite with such round dolerite crystals are known as 'roquefortite' granite (Photo B).

Roquefortite (photo B) displays a notable museum of igneous rocks! (photo 7a). The pillars are of an attractive pink granite known as 'Rose Granite', from quarries at Drumchapel in Scotland. The overall colour is due to the dark pink dolerite crystals, although the quartz crystals are an unusual pale blue, resulting from leaching by water movement, and the rock had crystallised. The bases of the pillars appear to be cut from Ballycastle Granite from Aberdeenshire, which is also used for the first in Sheffield Cathedral across the way. The dark variety of Lavender is used for the walls and jet another granite has been used for repairs below the right side. This rock shows evidence of the high temperatures at which it was heated, in that it contains dark green felds of highly crystalline material representing older rocks which got caught up in the molten granite and are now reduced to fragments of red granite, given the name 'transite', which means the same thing in Greek!

Turn left at the corner into Church Street and walk across to the Cathedral Crypt. Most of this building is constructed from local gritstone or sandstone. Recently, some of the pillars have been replaced using granite from Hanwood (Photo G). The new pillars are made from the pink granite of Ballycastle Granite from Ballycastle Park and the mid-sandstone surounds from Hutton in the Forest. The granite acts in the same manner as some of the other pillars inside the building. The column was moved from inside the Cathedral as recently as the 19th... (Photo H) and has been restored using granite from Sandstone (Photo J).

The two granite columns provide a good opportunity to compare the response to weathering of similar rocks. From the sandstone, then the pale granite forming the large memorial to James Montgomery and Henry close to the north wall of the Cathedral, a horizontal band made of slatestone (photo J). This is a variety of granite which would have been polished smooth, like some of the wall pillars inside the building. The column was moved from inside the Cathedral as recently as the 19th... (Photo H) and has been restored using granite from Sandstone (Photo J).

Looking diagonally across Campo Lane from this point is an excellent example of the use of stone to decorate a facade above. Wall Stone's office (ii). Large slabs of a metamorphic rock, probably granite, have been cut in two and then matched up next to each other, rather like opening the pages of a book (Photo J).

Either circumnavigating the Cathedral, or return your steps to Church Street.

The building of Church Street was built in local imitations and the Royal Bank of Scotland (ii) near the corner is no exception. The imposing pillars are of Percussion stones, (Photo H) in much better condition than on St Paul's Parade. Again, they contain some rounded dolerite crystals. The east of the building is constructed from Yorkshire Stone Hall Sandstone and the shorwe is of white granite from the South West of England.

The Centre Millhouse (i) is the focal point for the steel based industries of Sheffield and the old region of Rivelin. The left hand hall of the classical facade was designed by

Samuel Worth and Benjamin Taylor and constructed in 1837 of Yorkshire sandstone (Photo S).

In 1838, the width was virtually doubled, with an exact copy of the original design, using identical stone. The trim round the doors, of dark Lavender and natural stone, is in place.

If you wish to explore the River Don, the source of much of Sheffield's industrial wealth and now also the home of the Meadowhall shopping complex, you have only to keep on the main. The housing of Meadowhall is mostly a brown, red granite called the Grade Tredwernes---- but that is another story!!

A trip to the other direction will take you to the University of Sheffield and the City Museum. Alternatively, you could try out the activity sheet by working back up Furnace Court and visiting the stairs you missed on the way down. If the Town Hall is open, it is well worth studying the stones which have been used on the outside of the building.

The BUILDING STONES of SHEFFIELD

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Written by Peter Keen, with advice from Richard Night, Michael Farmer, Martin White, Peter York, and Stuart Cooper

Photographs by Peter Keen and Mark Inward Cooper

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St. C. T Cooper of Bourne Street, the Representative of the Council.

St. J. T. M. of St. J. T. M.


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For further information contact the Sheffield City Museum. Victoria Park, Sheffield S1. (0114) 273 3125

A Geological Walk in the City Centre
The Paving Stones of Fargate

The paving stones of the base of the forum form a grid pattern: one part of the grid is formed of sandstone blocks from Braithwell:
- Rough Brown Sandstone from near Langsett in South Africa
- Red Bottles Sandstone from near Langsett in South Africa
- Blue Pearl Limestone from near Braithwell

The paving stones are set out in a grid pattern, forming a base for the forum. The stones are arranged in a regular pattern, creating a sense of order and symmetry. The grid is composed of a variety of stones, each with its own unique color and texture. Some stones are smooth and polished, while others are rough and uneven. The stones are set in a precise manner, with each one carefully placed in its designated spot. This creates a visually appealing and functional surface, capable of supporting the weight of those who walk upon it. The grid pattern also serves as a guide for those who use the forum, helping them navigate the space with ease. Overall, the paving stones of Fargate are a testament to the skill and craftsmanship of the Roman builders, who created a space that has lasted for centuries and continues to be admired today.
Key to some rocks commonly used for ornamental purposes

- Sedimentary rock
- Igneous rock
+ Metamorphic rock

Gravestone or Building Stone

Does stone react vigorously when touched with acid dropper? (Check if this allowed)

No

Can you see the crystals or grains which make up the stone? (With a lens, if needed.)

Yes

Is the stone crystalline with crystals that interlock?

Yes

coarse crystals (easily visible with naked eye)

medium sized crystals (just visible with naked eye)

medium to light coloured, speckled

crystals arranged in bands

randomly arranged crystals

GRANITE°

GNEISS +

GABBRO°

DOLERITE°

SANDSTONE^*

SLATE +

MARBLE +

LIMESTONE^*

No

medium grey or green-grey

crystals arranged in bands

consists of rounded or angular sand grains cemented together

hard, dark grey, purple or greenish colour

sugary texture: may be veined or mottled

non-sugary texture: may contain fossils

http://www.earthlearningidea.com/
Note: This file is intended to provide an ongoing resource, as well as a basic activity in itself. It consists of a number of cards showing a wide range of rocks used in buildings such as shops, offices and banks; in work surfaces and in gravestones. A simple key is included, to enable pupils to identify the main types of rock, before they really take note of the detailed differences between them. The activity may be carried out using the cards in the classroom, or, preferably, ‘in the field’, i.e. in a town or city centre or a graveyard.

The late Fred Broadhurst showing teachers how to make use of the Trafford Centre, Manchester (Photo: Peter Kennett)

We hope to add to the variety of rock types as time and opportunity allow. We are also publishing activities based around each major group of rocks, i.e. sedimentary, metamorphic and igneous rocks, using the same cards, but asking pupils to develop their experience more fully. (See chart on page 7).

Building Stones 1
Give each small group of pupils a copy of the rock key and a complete set of photographs of building stones, printed individually onto card and trimmed to remove the labels. Point out that the coin is 2cm across, and that the photographs are all at natural scale. Arrange the cards in each set so that all the limestones (including travertine) and marble are separated. Since testing with acid is clearly not appropriate with photographs, tell pupils that the rocks shown on the separated cards would all react (fizz) with dilute hydrochloric acid, but that the others would not. (It will also be necessary to give this information when out with the class in a city centre, unless permission has been obtained to apply a drop of acid. Most graveyard managers will give permission for this test to be carried out on gravestones, since it merely results in a slightly cleaner-looking spot on the marble or limestone).

The back up
Title: Building Stones 1 – a resource for several Earthlearningidea activities.

Subtitle: Use a key to identify many different attractive-looking rocks.

Topic: A small group activity in the identification of a wide range of rock types, using natural-scale photographs of rocks used as building stones or for ornamental purposes. The sheets of photographs are intended for use as the basis for several further activities.

Age range of pupils: 8 – 80 years

Time needed to complete activity: 20 minutes for simple use of the key in the classroom, but much more for an outdoor visit to a town or city centre or a graveyard.

Pupil learning outcomes: Pupils can:

- follow a branching key;
- learn the criteria by which rocks are distinguished;
- identify a wide range of rock types;
- avoid the temptation to make a sample fit the key if it is inappropriate;
- (if using the photographs and not real specimens) – realise the limitations of using photographs without the opportunity to examine the real rock.
Underlying principles:
- In simple terms, sedimentary rocks are mainly non-crystalline and consist of fragments or grains cemented together. Metamorphic and igneous rocks are largely formed of interlocking crystals and are so impermeable. In igneous rocks the crystals usually show random alignment, but in metamorphic rocks they are often aligned. Some metamorphic rocks which do not show alignment e.g. marble, are made of one mineral but impurities sometimes show streaky patterns.
- Rocks containing carbonate minerals, i.e. marble and limestones, will react with dilute hydrochloric acid. (This should only be done with permission, although it leaves very little sign on the stone – and gravestones are sometimes cleaned using acid).
- Igneous and most metamorphic rocks are less porous than sedimentary rocks. They resist weathering better and are more capable of taking a polish on the displayed surface.
- Igneous and metamorphic rocks are often attractive in themselves, owing to the range of colours of their constituent minerals.
- The overall colour of an igneous or metamorphic rock is often controlled by small amounts of trace elements in the minerals. In a sedimentary rock, the composition of the (natural) cement which binds the grains together usually influences the colour of the rock.

Thinking skill development:
- The use of a key involves pupils in thought processes of construction.
- The fact that rocks such as granite may occur in many different colours may involve cognitive conflict.
- Working out of doors provides a good opportunity to make a bridge with normal classroom studies.

Resource list:

a) In class
- For the teacher’s reference: one copy of each of the sheets of photographs and their descriptions
- Per small group of pupils – a complete set of photographs of the rocks at natural scale, printed onto card and cut into separate pictures, without any captions.
- A copy of the key for the identification of building stones

b) In a town centre or graveyard
- For the teacher (optional) a small dropper bottle of dilute hydrochloric acid and a wash bottle of water
- Per small group of pupils – a complete set of uncut sheets of photographs, with captions
- A copy of the key for the identification of building stones

Useful links: ‘Will my gravestone last?’ from http://www.earthlearningidea.com
http://www.nationalstonecentre.org.uk
http://geoscenic.bgs.ac.uk/assetbank/action/viewAsset?id=344745&index=96&total=110&view=viewSearchItem

Source: Devised by Peter Kennett of the Earthlearningidea team, inspired by the enthusiasm of Eric Robinson and the set of sixteen postcards of Building Stones produced by Fred Broadhurst, Richard Porter and Paul Selden for the University of Manchester, and obtainable from Manchester Museum.

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Contact the Earthlearningidea team at: info@earthlearningidea.com
Building stone notes
(These brief notes are intended mainly for the teacher’s use, and have been written in a more technical style than the rest of the text. The date is the year in which the photographs were taken).

Igneous rocks - 1

South West England Granite, England (Ecclesall Churchyard, Sheffield, 2012)
There are many large outcrops of granite of Variscan age (late-Palaeozoic, 380-280 Ma, millions years old) in Devon and Cornwall, linked underground in a vast batholith. The specimen consists of white to buff-coloured feldspar, colourless quartz and dark ferromagnesian minerals, mostly biotite mica. The texture is slightly porphyritic i.e. some of the feldspars are larger than the average crystal size.

Kemnay Granite, Aberdeen, Scotland (Ecclesall Churchyard, Sheffield, 2012)
This granite is of Caledonian age (mid-Palaeozoic, 490-390 Ma). It is composed of quartz, feldspars and micas, in this case, mostly muscovite mica, which results in a pale grey colour, often with a hint of oatmeal colour. This rock has been used for the new Scottish Parliament building in Edinburgh.

Rubislaw Granite, Aberdeen, Scotland (Ecclesall Churchyard, Sheffield, 2012)
Rubislaw Granite is another Caledonian granite and is similar to the Kemnay Granite, except that a higher proportion of dark ferromagnesian minerals results in it being a darker grey colour. It usually exhibits some foliation (alignment of minerals), resulting from a later phase of Earth movements. The quarry from which it came is now a deep flooded hole, but it still retains the ‘Blondin Wire’ running across it, by means of which blocks of granite were lifted up from the quarry floor for cutting. It was very popular for gravestones in the Victorian period.

Rubislaw Granite with xenolith, Aberdeen, Scotland (Ecclesall Churchyard, Sheffield, 2012)
The dark inclusion within the granite is known as a xenolith (Greek for ‘rock stranger’). It represents some older rock broken off by the granitic magma as it intruded. The molten magma heated the loose block of rock so much that it became highly metamorphosed.

Balmoral Red Granite, Finland (Ecclesall Churchyard, Sheffield, 2012)
This rock was given the name ‘Balmoral Red’ at a time when Queen Victoria had made the Highlands of Scotland very popular, even though its only connection with Scotland was that it was imported from Finland via Aberdeen! The deep red feldspar and clear quartz, of uniform texture, makes this a popular rock for ornamental work. It is still quarried in Finland for use in repairs, but a similar-looking granite is now obtained in large quantities from China, much more cheaply.

Shap Granite, Shap Fell, Cumbria, England (Sheffield Law Courts, 2012)
Shap Granite is of Caledonian age and is noted for its highly porphyritic texture, where large pink well-formed crystals of feldspar are set in a ground mass of clear quartz, pink feldspars and micas. Xenoliths (known as ‘heathen’ to the quarry staff) are common, although not shown here.

Igneous rocks - 2

Ross of Mull Granite, Scotland (Ecclesall Churchyard, Sheffield, 2012)
Another distinctive pink granite, again due to the colour of the orthoclase feldspars. The clear mineral (which can appear quite dark at times) is quartz and the greenish mineral is hornblende. It was quarried on the Isle of Mull, right next to the sea, which made transport by ship very easy.

Imperial Mahogany Granite, Red Hills, South Dakota, USA (Jessops shop front, Sheffield, 2012)
The attractive red-brown colour comes from the feldspars, and the pale blue is quartz. The dark minerals are ferromagnesian minerals. The presence of blue quartz in an igneous rock usually indicates that it has undergone some degree of metamorphism after it had cooled. This is borne out by the appearance of subtle banding in the rock when seen in bulk. It is of Precambrian age (i.e. more than 542 Ma).

Rose Swede Granite, Graverfors, Sweden (Ecclesall Churchyard, Sheffield, 2012)
Again, the feldspars give the striking red colour to this rock, and the unusually deep blue of the quartz crystals provides the clue to a later phase of metamorphism. This is a Caledonian granite.

Peterhead Granite, Peterhead, Scotland (Ecclesall Churchyard, Sheffield, 2012)
As ever, the pink colour comes from the feldspars, and the clear, greyish mineral is quartz. There are very few ferromagnesian minerals in this Caledonian age granite, although it frequently contains dark xenoliths of older rocks which became caught up in the rising magma. It is a very popular stone in city centre buildings and gravestones, although it is no longer quarried.

Rosa Porrino Granite, Spain (Pisani plc, Cromford, Derbyshire, 2012)
This granite is actively extracted today from quarries in Spain, near the border with Portugal, and is frequently seen in shop fronts, gravestones and kitchen work surfaces. The usual combination of pink
feldspars, clear quartz and dark ferromagnesian minerals make up the rock, with the feldspars tending to clump together somewhat.

‘Baltic Brown’ Granite, Finland (Bank front, Yorkshire Bank, Sheffield, 2012) 
This Precambrian granite (i.e. more than 542 Ma) displays orbicular texture. The pink orthoclase feldspars have been made roughly spherical, probably by movement within the magma, and have then become coated with a greenish plagioclase feldspar as they cooled and the surrounding rock solidified. The dark minerals filling the spaces between the feldspars are ferromagnesian minerals. The rock is nicknamed the ‘Scotch Egg Rock’, from its resemblance to a British delicacy, a hard-boiled egg encased in sausage meat! The Finnish name is Rapakivi Granite, and the rock is currently popular in work surfaces in the U.K.

Igneous Rocks - 3

Larvikite – Blue Pearl, Oslofjord, Norway (Shop front, Pinstone Street, Sheffield, 2012) 
The only source in the world of Larvikite, both the Blue Pearl and the Emerald Pearl, is near the town of Larvik, on Oslofjord. However, huge quantities are shipped to India and China for processing and are then re-exported, which can cause confusion. Although related to granite, Larvikite has a smaller percentage of silica making up its minerals, so it is classed as an Intermediate igneous rock. (i.e. intermediate between silica-rich granites and iron/magnesium-rich gabbros). It consists mostly of feldspars and ferromagnesian minerals. The distinctive blue iridescent sheen comes from the feldspars and is called schillerisation.

Larvikite – Emerald Pearl, Oslofjord, Norway (Ecclesall Churchyard, Sheffield, 2012) 
See the notes for the Blue Pearl, above. Both colours of Larvikite are popular for work surfaces. There is considerable variation in colour, in both Emerald Pearl and in Blue Pearl, depending on which parts of the quarries are being worked

Alentejo Granite, Portugal (Kerbstones in Sheffield City Centre, 2012) 
The finer texture of this blue-grey granite means that it should correctly be called a microgranite, if not an intermediate igneous rock, to judge from the abundance of ferromagnesian minerals. It is now commonly used for kerbstones and rainwater channels at ground level.

This is known as ‘black granite’ in the trade but it is not a granite at all, although it is of slow-cooled igneous origin. The silica content of the minerals is lower than in granite and so the main minerals are grey feldspar and dark ferromagnesian minerals. There is no quartz. This example probably comes from the Bushveld Complex, near Johannesburg and is of Precambrian age (i.e. more than 542 Ma). A wide range of ‘black granites’ is now imported from India and China for ornamental purposes, for gravestones and for work surfaces.

Dolerite, source unknown (Ecclesall Churchyard, Sheffield, 2012) 
Dolerite is the medium-grained equivalent of gabbro, so the same comments apply as above. It is found in minor intrusions, such as dykes and sills, at no great depth below the Earth’s surface, where it cooled more quickly than gabbro, resulting in smaller crystal sizes.

Basalt, Italy (Pisani plc, Cromford, Derbyshire, 2012) 
Basalt is the fine grained equivalent of gabbro and dolerite, mostly formed when a magma of gabbroic composition reached the Earth’s surface, and erupted to form basalt lava. The rapid cooling resulted in a much finer grain size than either gabbro or dolerite. The sample in the photograph has been cut smooth, but has not been polished.

Sedimentary Rocks – 1

Portland Limestone, Isle of Portland, England (Sheffield City Library, 2012) 
Portland Stone was popularised by Sir Christopher Wren, when he used it in the rebuilding of St Paul’s Cathedral after the Great Fire of London in 1666, and it now features in many public buildings throughout the U.K. Examination under a hand lens shows that it is often composed of spherical ooids of calcium carbonate, 1mm or so in diameter. These were produced by the action of algae on a warm sea floor, and subjected to the action of currents, during the Jurassic Period (200-146 Ma). Shelly fossils of oysters resist weathering rather better than the bulk of the limestone and the extent to which they stand proud of the surface allows an estimate of weathering rates to be made when the age of the building is known, e.g. by using a tyre depth gauge.

The Roach Rock is part of the Portland Stone as described above, except for the remarkable preservation of the fossil gastropods and bivalves. (The gastropods are the ‘screw stones’ occupying most of the field of view: the ‘dimpled’ shape in the right hand corner is a bivalve, of Trigonia type). The fossils are preserved as moulds, formed where the actual animal shells pressed into the limey mud of the sea floor at the time. Later, the shells dissolved and the space was not taken up by other minerals, as usually happens. The gaps left in
Earthlearningidea - http://www.earthlearningidea.com/

The following chart shows the relationship between each of the activities on the theme of building stones. Each activity can be taken as a free-standing entity, since photographs and details of rocks are repeated. However, it is hoped that pupils will deepen their understanding of the topic and their enthusiasm for looking at the built environment around them by following all the activities in sequence, if this is appropriate to their local setting. The photographs were mostly taken using local opportunities in the U.K., but many of the building stones have come from across the world.

<table>
<thead>
<tr>
<th>Title of activity</th>
<th>Topic</th>
<th>Resources provided</th>
<th>Indoor activity</th>
<th>Outdoor activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building Stones 1 - a resource for several Earthlearningidea activities. (<em>BS1</em>)</td>
<td>Identification of building stones from each of the three groups of rocks.</td>
<td>Six sheets of photographs of building stones at natural scale, to be cut into separate photographs; Descriptions of all the stones; Key to the identification of building stones.</td>
<td>Identifying all the stones from the photographs, using the key; Competitive approach; opportunity for playing games with the photos.</td>
<td>Identifying building stones from the complete sheets of photographs, in a graveyard or town/city centre.</td>
</tr>
<tr>
<td>Building Stones 2 - igneous rocks</td>
<td>Using the photographs of igneous rocks to investigate their features in more detail and to comment on the conditions under which some of the rocks were formed.</td>
<td>Three sheets of photographs of igneous rocks, (taken from the whole set in BS1); Photographs of igneous rocks in use in a city centre; Descriptions of igneous rocks, as in BS1; A simple classification chart for the igneous rocks featured in the activity.</td>
<td>Grouping the photographs according to a) grain size; b) colour (and hence mineral content); Assessing the value of igneous rocks for ornamental or functional purposes.</td>
<td>Identifying building stones of igneous origin, from the sheets of photographs, in a graveyard or town/city centre; Explaining detailed features seen in igneous rocks used in buildings.</td>
</tr>
<tr>
<td>Building Stones 3 - sedimentary rocks</td>
<td>Using the photographs of sedimentary rocks to investigate their features in more detail and to comment on the conditions under which some of the rocks were formed.</td>
<td>Two sheets of photographs of sedimentary rocks, (taken from the whole set in BS1); Photographs of sedimentary rocks at outcrop, in use in a city centre and being processed for use as building stones; Descriptions of sedimentary rocks, as in BS1.</td>
<td>Relating the sedimentary rocks to their environments of deposition; Discussing their relative merits in resisting weathering; Showing how sedimentary rocks are cut for use, and why matching stones used in older buildings may be difficult.</td>
<td>Identifying building stones of sedimentary origin, from the sheets of photographs, in a graveyard or town/city centre; Explaining detailed features seen in sedimentary rocks used in buildings.</td>
</tr>
<tr>
<td>Building Stones 4 - metamorphic rocks</td>
<td>Using the photographs of metamorphic rocks to investigate their features in more detail and to comment on the conditions under which some of the rocks were formed.</td>
<td>One sheet of photographs of metamorphic rocks, (taken from the whole set in BS1); Photographs of metamorphic rocks at outcrop and in use in a city centre; Descriptions of metamorphic rocks, as in BS1.</td>
<td>Using evidence from photographs at natural scale and of metamorphic rocks outdoors to decide how they were formed and the factors affecting their use.</td>
<td>Identifying building stones of metamorphic origin, from the sheets of photographs, in a graveyard or town/city centre; Explaining detailed features seen in metamorphic rocks used in buildings.</td>
</tr>
<tr>
<td>Will my gravestone last?</td>
<td>Using a local opportunity to enable pupils to see a wide range of rock types and to investigate different scientific hypotheses.</td>
<td>An outline of how to conduct a graveyard survey, including suggested preparation and follow up activities; a plotting chart for pupils’ observations; Hypotheses which might be tested are suggested. The sheets from Building Stones 1 should be used for this activity.</td>
<td>Preparing for the graveyard visit, by revising pupils’ knowledge of sedimentary, igneous and metamorphic rocks. Following up the visit by assessing the validity of hypotheses about weathering rates etc and plotting graphs of data gathered during the visit.</td>
<td>Identifying ornamental stones from the complete sheets of photographs in a graveyard; Testing hypotheses regarding the rates of weathering of different rock types and the choice of different rock types over time.</td>
</tr>
</tbody>
</table>
South West England Granite, England

Kemnay Granite, Aberdeen, Scotland

Rubislaw Granite, Aberdeen, Scotland

Rubislaw Granite with xenolith

Balmoral Red Granite, Finland

Shap Granite, Cumbria, England

(1p coin is 2 cm in diameter)

All photographs by Peter Kennett
Ross of Mull Granite, Scotland

Imperial Mahogany Granite, South Dakota, U.S.A.

Rose Swede Granite, Sweden

Peterhead Granite, Peterhead, Scotland

Rosa Porrino Granite, Spain

‘Baltic Brown’ Granite, Finland

(1p coin is 2 cm in diameter)

All photographs by Peter Kennett
Larvikite – Blue Pearl, Oslo region, Norway
Larvikite – Emerald Pearl, Oslo region, Norway
Alentejo Granite, Portugal
Gabbro, South Africa
Dolerite, source unknown
Basalt, Italy

(1p coin is 2 cm in diameter)
All photographs by Peter Kennett
Cross-bedded sandstone (Carboniferous), Stanton Moor, Derbyshire, England

“Rockingstone”, shot sawn sandstone, (Carboniferous), Huddersfield, England

St Bees Sandstone (Triassic), Cumbria, England

‘Millstone Grit’ sandstone (Carboniferous), Derbyshire, England

‘Yorkstone’, (Carboniferous), West Yorkshire, England

Rudistid limestone (Cretaceous), probably Portugal

(1p coin is 2 cm in diameter)

All photographs by Peter Kennett
Metamorphic Rocks

Slate, with colour band from original bedding, North Wales

Broughton Moor Slate, Lancashire, England

Serpentinite, locality unknown

Gneiss, (‘Paradiso classico’), India

Verde Ematita, Argentina

Marble, Carrara, Italy

(1p coin is 2 cm in diameter)

All photographs by Peter Kennett
### Sheffield: the city that rocks

Rock weathering and decay - the mechanical breakdown of stone.

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<tr>
<th>Stone decay feature</th>
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<td>Blistering</td>
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<tr>
<td>Flaking (&lt;5mm)</td>
<td>Fl</td>
</tr>
<tr>
<td>Scaling (&gt;5mm)</td>
<td>Sc</td>
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<tr>
<td>Granular Disintegration</td>
<td>GD</td>
</tr>
<tr>
<td>Honeycombs</td>
<td>Hb</td>
</tr>
</tbody>
</table>

#### Blistering (Bl)

The picture shows blistering of Portland limestone on St Paul’s Cathedral in London. The most obvious explanation for the blister is that salt has gradually accumulated and crystallised at a shallow depth within the stone. Expansion and contraction due to repeated wetting and drying could then have lifted the surface layer away from the underlying stone. There may, however, be other explanations. For example, the formation of a case hardened outer layer to the limestone could cause the surface layer to expand and contract at a different rate to the underlying stone when heated and cooled. Eventually this may lead to the outer layer becoming detached. Each example should therefore be examined and interpreted individually.

#### Flaking (Fl)

The formation of thin, multiple flakes is most commonly associated with the rapid retreat of salt-laden stone. Often this takes place in hollows formed as the stone weathers back. This might suggest that the flaking is associated with repeated shallow wetting and drying of the stone by, for example the condensation of overnight dew. They may also be associated with the exploitation of weakened stone that has been exposed by the falling away of a surface scale. What appears indisputable, however, is that the primary process responsible for the flaking is salt weathering.

#### Scaling (>5mm)

Because scales often follow the surface detailing of a stone this is also referred to as ‘contour scaling’. Scaling is often linked to the accumulation of salt at a frequent wetting depth within the stone and the eventual lifting away of the outer layer - this may first be manifested as a blistering of the surface [see above]. Scales may also form when a hardened outer surface, for example, an iron-rich alteration rind, breaks away from underlying stone that has been weakened by a gradual loss of its iron cement (see alteration features).

#### Granular Disintegration (GD)

This occurs in granular (e.g. sandstone) and crystalline (e.g. granite) stones where, for example, the cement holding the grains together is weakened by solution or where salts crystallise in pores to force individual grains apart. In crystalline stones this may need an earlier, preparatory stage of weathering - perhaps limited chemical alteration or a series of severe frosts - which opens up a network of micro-fractures that the salts can enter and exploit. Typically granular disintegration produces debris that is a mixture of salt and individual grains that is referred to as ‘rock meal’ and can often be seen accumulating beneath stones that are actively decaying.

#### Honeycombs (Hb)

Effects such as multiple flaking and granular disintegration are frequently associated with salt accumulation and are often found in humid, shaded areas where salts are protected from solution loss by rain and rainwash. These areas may begin simply as a patch of stone that has, for example, different porosity characteristics and is more susceptible to weathering. However, once the stone starts to weather it creates a hollow that in turn encourages further salt retention. This ‘positive feedback’ means that salt weathering often results in the hollowing out of the stone to give a honeycomb appearance. The initial spacing of the hollows may be related to minute variations in stone properties and weathering creates a roughening of the stone surface. As weathering continues, small depressions either merge or become overwhelmed by adjacent hollows. Through this process of self-selection, collections of what appear to be optimally-sized honeycombs develop and can replace the complete surface of a block.
| **Caverns (Tafoni)**<br>CS | In addition to honeycombs, larger hollows also develop that may eventually destroy complete blocks of stone. The same principles of positive feedback apply as for honeycombs and in some cases tafoni may be initiated by coalescence of a patch of the smaller hollows. The size of the caverns can be controlled on a building by the dimensions of individual blocks that weather and retreat more rapidly than surrounding stonework. However, tafoni also occur on cliff faces in natural salt-rich environments and their dimensions may be related to the creation of hollows that provide the optimum environment, in terms of humidity, heating and cooling and salt deposition and retention, for salt weathering to occur. One special case for their formation is where hardened outer crusts on stone are breached and the weaker stone is hollowed out. The consensus is that tafoni are primarily the product of salt weathering. |
| **Cracked Stones**<br>CS | In reality, the creation of cracks running through blocks of stone is not a particularly common feature on buildings. In most instances they can be traced back to poor workmanship or design. For example, in old buildings so-called ‘fieldstones’ may have been collected and used rather than quarry fresh stone. These would have a history of exposure to weathering and may contain incipient fractures that are them exploited.Cracking can also derive from the unequal loading of the stone in the building and where metal fixings corrode and expand. Although relatively rare, when such damage is seen it must be treated seriously, as it may have structural implications for the building. |

Source: adapted from Queen’s University Belfast, School of Geography Weathering Research Group [http://www.qub.ac.uk/geomaterials/weathering/mechanical-breakdown.html](http://www.qub.ac.uk/geomaterials/weathering/mechanical-breakdown.html)
GA Conference 2018: Sheffield
Sheffield: The city that rocks
A fieldwalk to explore the urban geology of the city centre
Duncan Hawley
Physical Geography Special Interest Group
duncan.hawley.geography@gmail.com

Building stone trails and resources

Looking at Buildings
An online guide to architectural style and materials.
http://www.lookingatbuildings.org.uk/index.html

Spot that rock
How to help students distinguish between igneous, sedimentary and metamorphic rocks by their ‘reliable’ characteristics and link to their ‘useful’ properties.

Virtual Rock Kit
Online examples of rock types in different views (hand specimen, exposure, close-up, thin section, x-polars and rock in use)
http://www.earthscienceeducation.com/virtual_rock_kit/index.htm

Earth Learning Idea
http://www.earthlearningidea.com/PDF/140_Building_stones_sed.pdf
http://www.earthlearningidea.com/PDF/143_Building_stones_met.pdf

Sheffield
http://www.geologyatsheffield.co.uk/sagt/building_stone_walk
http://www.geologyatsheffield.co.uk/sagt/building_stones

Birmingham
Building Birmingham: A tour in three parts of the building stones used in the city centre.
Part 1 leads from Birmingham Town Hall to the Cathedral,
Part 2 visits Centenary Square and Brindley Place
Part 3 examines the stones used in the retail districts from the ‘Back of Rackham’s’ to the Bullring.
http://bcgs.info/pub/local-geology/building-stone-trails/

Cardiff
Building Stones of Cardiff 1. Cardiff Bay
http://www.swga.org.uk/pdf/CardiffBay.pdf

Building Stones of Cardiff 2. Cathays Park

Newport (South Wales)

Cambridge
Cambridge Geology Trail
Tour guide available from The Sedgwick Museum Shop
The trail is based on a building stones walk compiled by Dr. Nigel Woodcock from the Department of Earth Sciences. His aim was to introduce first year undergraduate students to looking at geology out of the classroom.
Edinburgh
http://edinburghgeolsoc.org/downloads/lgcleaflet_southside.pdf

Glasgow (university campus)
https://www.geologyglasgow.org.uk/docs/017_074_buildingstonesofgu3_1379081044.pdf

Nottingham
Geology walk through the university campus
Town centre, Market Square (description of materials used in refurbishment.

Bristol (Clifton)
Building stones of Clifton trail: a 30 minute short walk
http://avonrigsoutcrop.blogspot.co.uk/2013/06/the-building-stones-of-clifton-walking.html

Guildford
http://www.lougs.org.uk/localgeo/Guildford_Building_Stones.pdf

Painton, Devon
A wander through Painton in Devon, part of the South West Coast Path.
https://www.southwestcoastpath.org.uk/print-walk/741/

Herefordshire & Worcestershire
http://www.buildingstones.org.uk/building-stones/

Stratford-upon-Avon

Bedfordshire Building Stones
A guide to the building stones that can be found in locations across the county, so not a town trail as such, but a valuable resource nonetheless.
http://www.bedfordshiregeologygroup.org.uk/leaflets/RIGSBuildStones.pdf

London Urban Geology
Twenty Building Stone walks in central London, devised by Dr Ruth Siddall of University College, London. The final walk in this series is ‘Pub Geology’ – a tour of London’s Victorian pubs...this one may be more suitable for teachers rather than students!
http://www.ucl.ac.uk/~ucfbrxs/Homepage/UrbanGeology.htm

Video
British Geological Survey video explaining building stones
https://youtu.be/bWeef_9FP1s

Map
Building Stone Resources of the United Kingdom
Published by the British Geological Survey (2006) in collaboration with the heritage organisations of England, Scotland and Wales. The base is a geological map plotted with the location of key quarries and the principal stone types. An online version is available at:
http://www.largeimages.bgs.ac.uk/iiip/mapsportal.html?id=1004602
Poster version is available for purchase from the BGS bookshop (£6.25 + shipping)
http://shop.bgs.ac.uk/bookshop/subcategory.cfm?SERIES_ID=A1600