Picturing metamorphic rocks
Visualise and draw metamorphic rocks from a verbal description

Encourage pupils to look carefully at metamorphic rocks and to describe them verbally so that another person can visualise them from the description.

Seat pupils in pairs, with each person holding half of the photograph cards showing metamorphic rocks, printed off from those shown below. They should NOT show each other what cards they have in their hands.

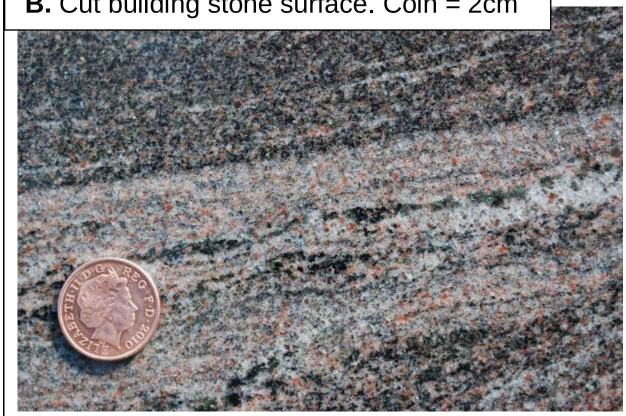
Pupil A then examines one photograph and describes it as fully as possible to Pupil B, who listens carefully and then tries to draw it. Pupil B must listen in silence and not ask any questions. Pupil B then takes a turn with another card, with Pupil A doing the drawing, also in silence. Neither person should use any technical terms which describe the rock, e.g. 'schist', but they may use more general words, such as 'crystals', 'alignment', 'grain size'. They may tell their partner whether they are looking at a landscape scale photograph, a hand specimen or a thin section (in plane polarised light). Pupils should then compare their hand-drawn efforts with the photographs.

This first round should be tried without any guidance. Then give each participant the Prompt Card, to encourage them to be more specific in further descriptions, and ask them to work through the remaining photographs, comparing their drawings with the photographs after each round. Note that some rocks may be repeated on different photographs.

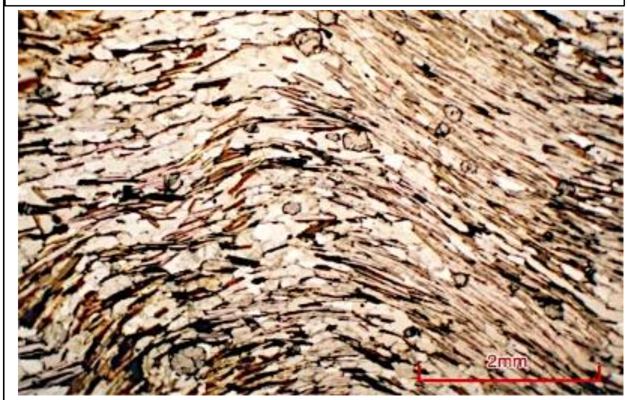
When all have finished, give out the descriptive cards and ask pupils to match the descriptions to the photographs which they have been using.

A. Flat surface of hand specimen. Coin = 2cm

B. Cut building stone surface. Coin = 2cm



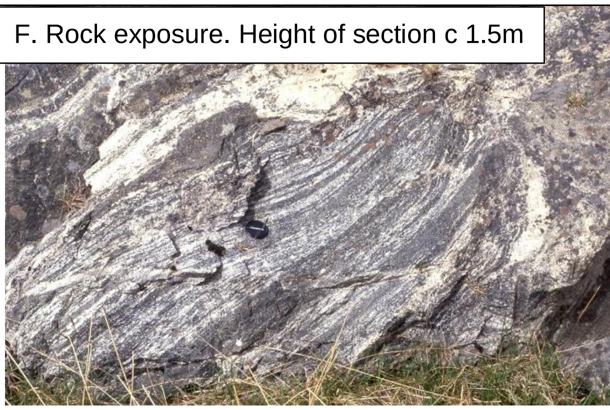
C. Magnified rock slice. Width of view = c.7mm



D. Hand specimen

E. Hand specimen with smaller aligned crystals around large crystals.

F. Rock exposure. Height of section c 1.5m



G. Hand specimen that reacts with dilute acid. Coin = 2cm

H. Rock exposure. Width of view c.1.5m

I. Magnified rock slice of a carbonate rock Width of view c.3mm

J. Hand specimen. Width of specimen c.10cm

K. Hand specimen of a rock that does not react with acid

L. Hand specimen that reacts with dilute acid.

Prompt Card
Use this card as a check list to aid your verbal description of your photographs to your partner
Does the photo show a hand specimen, a thin section, or a rock exposure?
For a hand specimen or thin section:
    What is the grain size of the rock?
    Does the grain size vary across the rock in the photograph?
    What is the shape of the grains and the relationship between them?
    Is there any alignment of the grains?
For a rock exposure:
    Are any large scale structures visible?
In any photograph:
    Are there any relict structures from the original rock which have survived metamorphism?

Descriptions of the photographs

1. Hornblende gneiss, Isle of Coll, Scotland. A coarse-grained, rock composed of bands of pale feldspar and quartz alternating with bands containing hornblende and other dark ferromagnesian minerals. The darkest bands may represent original igneous rocks like basalt which have been metamorphosed. The whole exposure has been affected by strong deformation.	7. Marble in thin section, locality unknown. The original carbonate minerals in the limestone from which the marble is derived have recrystallised under increased temperature or pressure. They form a tightly interlocking network, with mostly polygonal outlines.
2. Marble, Greece. The term marble strictly applies only to limestones which have been recrystallized by metamorphism. This is a coarse-grained example, with tightly interlocking crystals forming polygonal outlines.	8. Schist in thin section, locality unknown. A medium-grained rock consisting mainly of mica crystals. These show a very strong alignment (foliation), which is distorted to give a “wavy” appearance to a hand specimen.
3. Gneiss, locality unknown. The rock is coarse-grained and shows distinct bands of different minerals. These include white and pink feldspars, clear glassy quartz and dark ferromagnesian minerals, probably biotite mica and possibly hornblende.	9. Skyros Marble, Greece. The term marble strictly applies only to limestones which have been recrystallized by metamorphism. In this example, darker impurities within the original limestone have become streaked out by regional metamorphism to give the bands of colour, for which the marble is prized as an ornamental stone.
4. Garnet-mica schist, South Orkney Islands. Large reddish garnet crystals up to 2cm across are set in a medium-grained ground mass, mainly composed of mica and quartz crystals. These minerals are aligned to give wavy glistening surfaces, known as foliation. The garnets grew under pressure, deep in the Earth’s crust. When large crystals occur in a finer grained ground mass in a metamorphic rock the texture is referred to as porphyroblastic.	10. Cross-bedded metaquartzite, Garve, Rosshire, Scotland. The quartzite has been produced by regional metamorphism of a cross-bedded sandstone. Although the cross-bedding is a sedimentary structure, metamorphism has not destroyed it. Such features are called “relict” when they occur in metamorphic rocks.
5. Chiastolite “slate”, Glenderaterra Valley, Lake District, England. This is a hardened mudstone, which has been affected by the heat of the Skiddaw Granite, resulting in the formation and growth of a new mineral, chiastolite. (a variety of aluminium silicate). The chiastolite crystals have a random orientation because the thermal metamorphism occurs under very low lateral pressure.	11. Interbedded metaquartzites and slate, Elan Valley, Wales. Regional metamorphism has affected a sequence of sandstones and shales, resulting in metaquartzite and slate. The slate has acquired a cleavage at an angle to the bedding while the quartzite has remained largely unaffected, since it contains few clay minerals. The cleavage has a steeper angle than the bedding, showing that the rock sequence is the ‘right way up’ i.e. has not been inverted.
6. Green slate, Borrowdale, Lake District, England. The slate is derived from the metamorphism of fine-grained volcanic ash. The coloured layers show relict graded bedding. The cleavage produced by metamorphism is parallel to the surface of the slab. The slate was affected by more stresses after metamorphism, resulting in a reverse micro-fault.	12. Slate, North Wales. Slate is produced by the regional metamorphism of mud rocks. The colour banding is a relict feature, i.e. it represents the original bedding which has not been destroyed by metamorphism. The cleavage of the slate is parallel to the top surface, at a high angle to the original bedding.

The back up

Title: Picturing metamorphic rocks

Sub-title: Visualise and draw metamorphic rocks from a verbal description

Topic: Enhancing pupils' skills of description and interpretation using photographs of metamorphic rocks and various scales

Age range of pupils: 16 years and above

Time needed to complete activity: About 30 minutes, depending on depth of discussion

Pupil learning outcomes: Pupils can:
- examine photographs of metamorphic rocks carefully and describe them intelligibly;
- listen carefully to a verbal description and interpret it in a drawing;
- demonstrate their understanding of the nature and origin of metamorphic rocks;
- enhance their observational skills as a prelude to field work.

Context: This could form a useful revision activity, once pupils have studied metamorphic rocks. Answers to the matching exercise are:

A6	B3	C8	D5	E4	F1
G9	H11	I7	J12	K10	L2

Following up the activity:
- Adopt the same approach to real specimens, if you have them, or to photographs of other items of geological significance.
- Ensure that pupils use the same careful description and interpretation approach to geology in the field.

Underlying principles:
- Metamorphic rocks contain essential clues to their mode of origin.
- This strategy provides training in careful observation and interpretation of all relevant features.
- Being obliged to give a verbal description encourages careful observation, to ensure that clues are not missed.

Thinking skill development:
Verbal dexterity and metacognition are encouraged by the need to give intelligible verbal descriptions and to interpret from them**.** Mental patterns are constructed of the relationship between metamorphic rocks and their origins. Applying the activity to real specimens or to the field situation is a bridging activity.

Useful links:
https://www.earthlearningidea.com/PDF/143_Building_stones_met.pdf

Resource list:
- card sets of Photographs, Prompt Cards and Description Cards, cut out from those shown above.
- if real specimens are available these may be used instead, with appropriate matching descriptions drawn up by the teacher (although it is harder to hide real specimens from each other).
- a ruler and protractor per pair might encourage accurate observation and description.

Source: Written by Peter Kennett of the Earthlearningidea Team. Photos C and I from the Virtual Rock Kit © Earth Science Education Unit, Photo K is P521238 © British Geological Survey. Other photos by Peter Kennett.