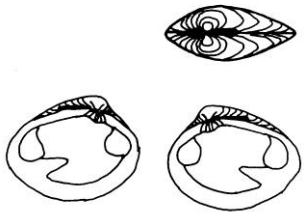
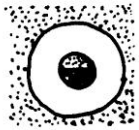
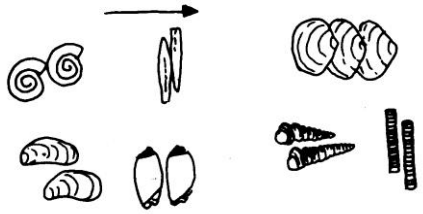
Guide to using large blocks in stone walls to investigate rocks

Part 1 - Identifying the rock type

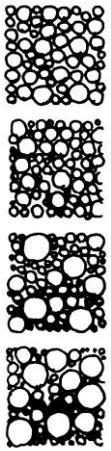
Question	Answer	What does this tell you?
Can layers be seen in the rock?	Yes No	Most likely to be sedimentary bedding. Could be metamorphic banding. Could be igneous (volcani-clastic) layering. Most likely to be igneous rock.
Are layers picked out by: - changes in colour? - differences in how the rock has weathered? - changes in grain size?	 Yes Yes Yes	 Different minerals in the bed of sedimentary rock (or in the bands (foliation) of the metamorphic rock). Differential weathering is linked to mineral composition. (Some minerals weather out more easily). Most likely to be of sedimentary origin (grains settle at different rates or are sorted by sedimentary processes).
Can fossils be seen in the rock?	Yes	Most likely to be sedimentary rock. (Fossils sometimes found in low grade metamorphic rock, but are very rare in igneous rock).
Can crystals be seen in the rock?	Yes	Most likely to be an igneous or metamorphic rock.
Identify the rock as igneous, sedimentary or metamorphic? (Give reasons for your conclusion).		

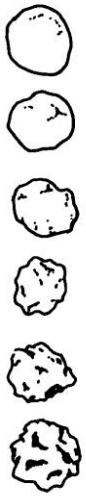
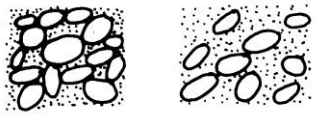
Part 2 - Using the fossils in the sedimentary rock **Part 2 Sheet 1**

Question	Answer	What does this tell you?
What types of fossils can you see?	Coral Brachiopod Bivalve Gastropod Crinoid Trace fossil Belemnite Ammonite	Sediment deposited in a warm, shallow, marine environment. Sediment deposited in a shallow marine environment. Sediment deposited in water. (Could be marine or freshwater). Sediment deposited in water. (Could be marine or freshwater). Sediment deposited in a (shallow) marine environment**.** Sediment deposited on land or in water – greatest abundance in marine. Sediment deposited in a marine environment Sediment deposited in a marine environment
Are the fossils articulated or disarticulated? 	Articulated Disarticulated	Probably preserved in their life position Not much!
Are the fossils fragmented? Complete Fragmented 	Yes	Fragmented shells indicate evidence of transport or long period of time lying on the sediment surface. (Mechanical fragmentation caused by strong current activity; shell destruction by biological activity - borers; predators, algae)
Are the fossils well sorted?	Yes No	Indicates sustained transport by a steady current or winnowing by waves. May indicate rapid sedimentation.

Question	Answer	What does this tell you?
	Yes	May represent *in situ* life assemblage or a well-winnowed transported assemblage.
Are the shells convex up? 	Yes	Usually indicates shells were deposited from a current; this is the most stable position.
Are the shell cavities partially filled with sediment? e.g. Bivalve  e.g. Crinoid 	Yes	Geopetal structures like this show the original horizontal at the time of deposition.
Do the fossils show a preferred orientation? The arrow shows the current direction: 	Yes – in life position Yes – not in life position	Took up this position in response to light, gravity, nutrient-supplying currents. Most likely to be orientated after death by wave or current action.
What conclusions can you draw about - **the environment of deposition?** - **the age of the rock?** **(Give reasons for your conclusions)**		

Part 3 - Using the grain size of clastic sedimentary rocks **Part 3 Sheet 1**

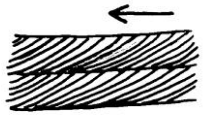
Question	Answer	What does this tell you?
What is the average size of the grains? (Measure the size)	>2mm 0.06 to 2mm <0.06mm	Coarse grain size. (Granules<pebbles<cobbles<boulders) Medium grain size (Sand: very coarse-coarse-medium-fine-very fine) Fine grain size ((Clay<silt) difficult to see. (For sediment sizes > fine sand, the coarser the material the greater the flow velocity needed to erode, transport & deposit the grains).
Are the grains the same size or of different sizes?	Same size Different	Sediment was sorted out during longer transportation. (Perhaps moved a long distance by a river or for a long time in the sea). Sediment was probably deposited close to its source or deposited quickly.(e.g.by a flood or from meltwater).
Are the grains: - very well sorted? - well sorted? - Moderately sorted? - Poorly sorted?		Generally - sorting improves along the sediment transport path. Poorly sorted sediments were usually deposited quickly (e.g. in storm beds or from flows/mudflows). Better sorted sediments may have been reworked by wind or water. (e.g. sand deposits on beaches, in shallow seas or in deserts)

Question	**Answer**	**What does this tell you?**
Do the grains have a roughly spherical shape? High sphericity V Low sphericity 	Yes No	Not much – the sphericity of grains mainly depends on the physical properties of the source material.
Do the grains have: - well rounded shapes? - rounded shapes? - - sub-rounded shapes? - sub-angular shapes? - angular shapes? - very angular shapes?		Generally – the more rounded the grains are the more they have been moved around (i.e. the longer the length of time or distance they have moved).
Are the grains densely or loosely packed?	Densely	Packing depends on grain size, shape & sorting, but rocks with densely packed grains often have lower porosities.
Do the grains have a grain-supported or matrix-supported fabric? e.g. grain-supported V matrix-supported 	Matrix-supported Grain-supported	For conglomerates this is a common fabric of debris flow deposits & glacial flows & tillites. Grain-support fabrics can indicate intensive reworking by currents &/or waves or deposition from turbulent flows where fine sediment is held in suspension longer (& separated from coarser sediment). For conglomerates this is a common fabric of deposits formed in river channels, by stream floods & on beaches. Generally – the greater the amount of matrix the less chance the grains will just touch each other.

Question	**Answer**	**What does this tell you?**
Do the grains show a preferred orientation or are they randomly orientated? e.g. Preferred orientations: imbricated flat lying  	Yes – grains in gravel stacked like tiles on a roof (imbricated) Yes - flat lying Yes - randomly orientated	Imbricated - shows the current flow direction. Flat lying grains - usually mica grains. Not much!
What conclusions can you draw about the rock? **(Give reasons for your conclusions**		

Part 4 - Using the sedimentary structures of sedimentary rocks **Part 4 Sheet 1**

Question	Answer	What does this tell you?
Does the rock show lamination (layering mm thick)?	Yes	In fine sands & clays – probably formed by deposition from suspension. In medium sands – probably formed by turbulent flow at high velocities. In coarse sands – probably formed by bedload transport at low flow velocities.
Does the rock show bedding (layering > 1cm thick)?	Yes	Layers of sediment were deposited at intervals. Bedding planes can represent long or short breaks in deposition.
Are the bed junctions sharp or gradational?	Sharp changes Gradational changes	Sharp bed junctions may be erosional. (Check for evidence of erosional structures on bed under surfaces {soles} like flute casts & groove marks). Other structures to look for at sharp bed junctions {at the tops of beds} are: desiccation cracks & ripple marks. These gradational bed junctions indicate there were gradual changes in the conditions under which sediments were transported & deposited.
Does the rock show “layers” that are irregular & cut across grains? 	Yes	These are “layers” are stylolites - produced by pressure solution.

Question	Answer	What does this tell you?
Does the rock show cross bedding? e.g. The arrow shows current directions 	Yes	Cross beds show the palaeocurrent direction (flow direction of the wind or water current that formed them).
Does the rock show: • tabular cross bedding?  • Trough cross bedding? 	Yes Yes	Usually formed by sand waves or by straight-crested dunes. Usually formed by lunate or sinuous (i.e curved) dunes.
Does the rock show graded bedding? 	Yes	Coarse to fine grading formed by deposition as currents slow down. (Coarser grains deposited first from fast flowing current)
Does the rock show ripple marks? Are these: • asymmetrical?  • symmetrical? 	Yes Yes Yes	Sediment moved & deposited by waves or wind/water currents. Current ripple marks formed by wind or water currents. These show the palaeocurrents direction (flow direction of the currents that formed them). Formed by waves as currents move sediment forwards & backwards. The crests of the ripples are parallel to the direction of the waves.

Question	**Answer**	**What does this tell you?**
Does the rock show convolute bedding or slump structures? 	Yes	Soft sediment may have deformed during dewatering as water moved up through the sediment. Mass of sediment may have collapsed & slumped down a slope.
Does the rock show sole structures (structures found on the base of the bed)? Are the sole structures: • flute casts? • groove marks?	Yes Yes Yes	Structures were formed by erosion by water & sediment-laden flows. Probably formed by turbidity currents, These show the direction of flow of the turbidity current. Cut by a tool (a fossil or clast) dragged along the sediment surface by the current. These indicate the trend of the current.
What conclusions can you draw about the rock? **(Give reasons for your conclusions**		

Part 5 - Using the crystals in igneous rocks **Part 5 Sheet 1**

Question	Answer	What does this tell you?
What is the average size of the crystals? (Measure the size)	>2mm 0.06 to 2mm <0.06mm	Coarse crystals formed as magma cooled slowly deep in the crust. Medium crystals formed as magma cooled in the crust, nearer the Earth's surface. Fine (difficult to see) crystals formed as magma cooled quickly (perhaps as lava at the Earth's surface).
Are the crystals: • the same size?  • different sizes? 	Yes Yes	The crystals formed in a single stage of cooling. Magma may have cooled in two stages. (Perhaps initial slower cooling formed larger crystals {phenocrysts})?

		Part 5 Sheet 2
Question	**Answer**	**What does this tell you?**
Are the crystals: • euhedral (nearly perfect crystal shape)?  • anhedral? 	Yes Yes	Usually the first crystals to form – & so had unrestricted growth. Usually the last crystals to form – the crystals filled in the gaps.
Does the rock have a dark colour?	Yes No	The rock probably contains a high proportion of dark minerals (e.g. pyroxene {augite}) that are rich in iron (Fe) & magnesium (Mg). The pale colour indicates the rock contains a high proportion of minerals like quartz & feldspar that contain no Fe or Mg.
Describe the minerals you can easily see.	White or pink + rectangular shape Grey, glassy + hexagonal shape Dark green/black, 2 cleavages Shiny/silvery, + tabular crystals Black/dark brown, shiny, + tabular crystals Olive green, glassy, often rounded	Probably feldspar Probably quartz Probably pyroxene (augite) or amphibole (hornblende) Probably muscovite mica Probably biotite mica Probably olivine

Question	**Answer**	**What does this tell you**
Does the rock contain patches of rock of different composition/colour or grain size?	Yes	These xenoliths may be pieces of country rock that were broken off as the magma rose upwards.
Do the phenocrysts appear to show a preferred orientation? 	Yes	Crystals may be aligned in the flow direction of the magma. (**Hint:** Try measuring the directions (0 – 360º) of the long axes of the phenocrysts. Plot the results on a rose diagram. What conclusions can you draw?)
What conclusions can you draw about the rock? **(Give reasons for your conclusions**		