Funded by Defra's Aggregates Levy Sustainability Fund, administered by English Nature.

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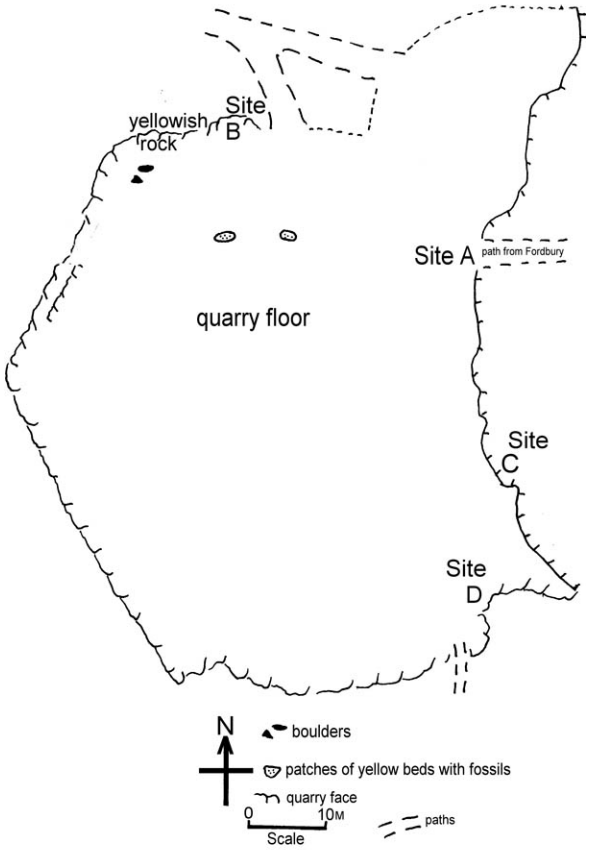
ACTIVITY SHEET 1 **Pupil Name .....**

Site A: - A First Look At The Quarry



Activity 1.

Use a compass to find North.

a) Mark North [or **N**] on the compass rose at the bottom of the map.

b) Circle site A, your first view of the quarry.

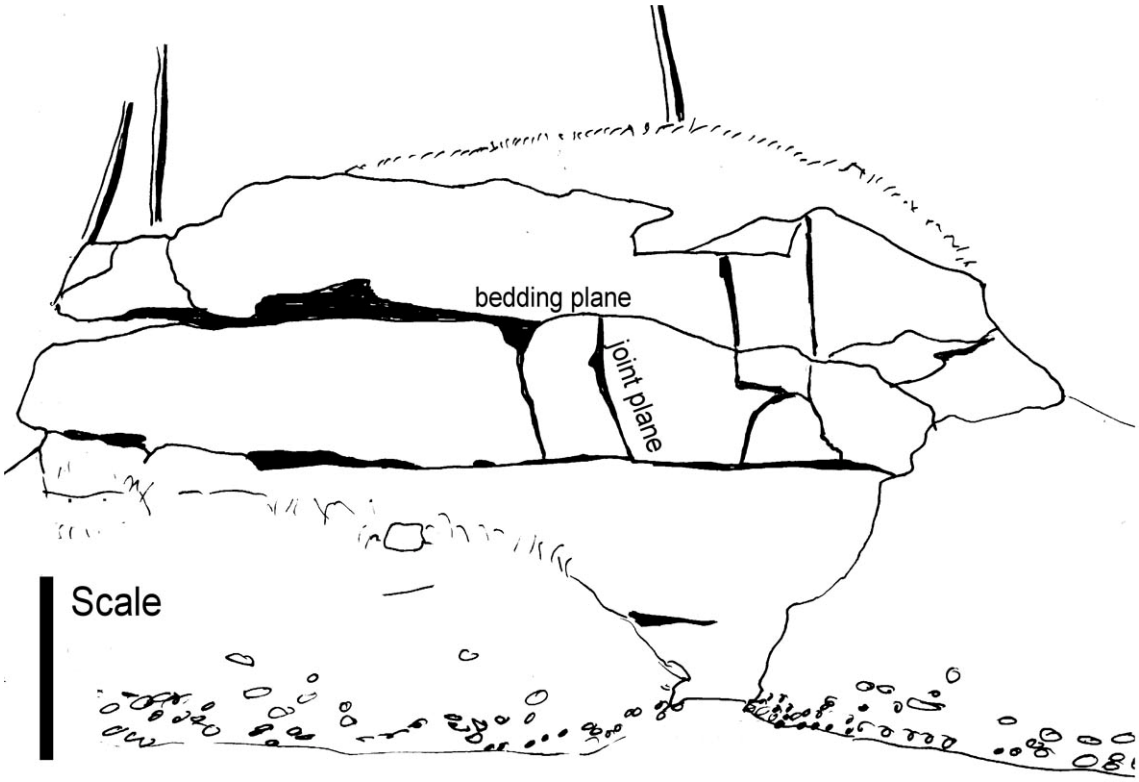
At each later stop you will need to check and circle the site on your map.

Activity 2. Look west to the main faces of yellowish rock.

Questions	Answers
What clues can you see that tell you that this was a quarry and **not** a natural landscape?	Flat quarry floor. Cliff faces cutting into the land surface, through soils and rocks. No stream or river which might have been responsible.
Which TWO of these words best describe the yellowish rock in the quarry faces? **Layered;** **Jumbled up** **Level**, [horizontal]; **Tilted** [sloping]	Word 1: Layered Word 2: Level/horizontal
You should be able to see material at the base of the faces. What do you think this is made of? Where has it come from?	This is scree. It is made of broken rock fragments weathered from the faces and fallen by gravity.

ACTIVITY SHEET 2 **Pupil Name .....**

Site B: - View from 20m



Activity 3.

Match this sketch with what you can see in the cliff face. Rock layers are called beds.

Mark on the sketch above:

1. **Youngest bed** [You might have done an activity in school to help you to answer]
2. **Soil with trees**
3. **Scree [made of broken rock**]
4. **Quarry floor**
5. **Use the scale bar to estimate the height of the cliff** face to the nearest metre.

Write your answer here: ___**about**__3___metres

6. **Circle site B** on your map on activity sheet 1.

ACTIVITY SHEET 3 **Pupil Name .....**

Site B: – A close look at the rocks (i)

You will need a magnifier, small piece of 1mm graph paper, dropper bottle of water, dropper bottle of dilute acid.

Activity 4. Let's take a closer look at the rocks either in the face or loose pieces lying around.

Describe a piece of the rock.	Yellow colour, made of grains etc.
What happens when you rub the rock with your fingers?	Some grains may rub off.
Look at the main grains in the rock with a magnifier. Describe the shape of the grains: rounded, angular or in between.	Mostly rounded.
Describe any others you can see, helping to stick the grains together.	Smooth yellowish clay helps. Some grains of quartz sand are also present.
Measure the size of the grains: Over 1mm, about 1mm, under 1mm. [1mm graph paper is useful]	Mostly about 1mm, a few over 1mm. [the size of fish eggs. Anyone seen caviar??] [Ruler could be used]
Test the yellow rock with a drop of dilute acid. What happens?	It fizzes
The rock is made of tiny balls of lime, the size of fish eggs. It was originally lime mud, made mostly of the mineral, calcite, which rolled around on the seabed like a tiny snowball, picking up more lime mud as it rolled around. What name can we give to such a rock containing so much lime?	Limestone.
You might be able to find fossil shells of sea creatures. What does this tell us about where these rocks were formed?	It was formed in the sea. (You may find brachiopods, bivalves etc.)
Try to explain why the rocks are layered. [You might have done an experiment in school with water and sediments like sand and mud]	Lime sediment was washed about and settled out in water.
How many types of rock can you see here?	One: limestone [both the dark rock in the floor of the quarry and the yellow rocks are limestones]
Most rocks in England are layered and made originally of soft sediments. What name is given to this major group of rocks?	Sedimentary

ACTIVITY SHEET 4 **Pupil Name .....**

Site B: – A close look at the rocks (ii)

Activity 5. Look at the top of the quarry. You may notice that some of the beds of rock have been worn away over all those years, long before the quarrying took place.

What is the name for the limey/sandy/clayey material lying on top of the rocks? Your teacher may collect a sample for testing back in school.	Soil.
As well as limestone, sand and clay, what is it made of?	Plant roots, decaying plant materials, minibeasts etc water & air.
How do you think soil is formed?	Rocks are being broken down all the time by weathering processes. These include acid rain and freeze-thaw.
Describe where some of the tree roots are growing.	Down the cracks [joints] and along the bedding layers.
Look at the scree material at the bottom of the faces. What is it turning into?	It is turning into soil.
Try to identify some plants growing in the new soil on the scree slopes.	Silver birch and other tree saplings. Grass, plus others – identification depends on season! Moss & lichen in dark, damper areas, especially in southern part of the quarry.
Even on the hard surface of the limestone you should find places where tiny plants are growing. Try to describe and identify any you see.	Green mosses & green/black lichen.
What clues have you found to show that animals live in the soil in this area?	Worm casts. Mole hills. Rabbit burrows and droppings.
In this part of the quarry the faces have been cleared of most trees and other plants. Why do you think some faces have been cleared? Why do you think it is important?	To expose the rocks for people to look at! For education!!
Look at the southern part of the quarry. What is happening to the quarry?	It is becoming overgrown/colonised by trees and other plants.
Test the limestone with a water dropper. Is it porous or not?	Water soaks in, the limestone is porous.
There don't seem to be many streams or ponds in the area on top. Where do you think the water goes to when it rains?	Soaks into the ground, into the porous rocks.
What do we call the place where water comes out of the ground naturally?	A spring.

ACTIVITY SHEET 5 **Pupil Name .....**
Site B: – A close look at the rocks (iii)

Activity 6. We have seen this limestone used for walls and buildings in the local area.

What is it about the yellow limestone that makes it so useful for buildings?	It splits into layers, is easy to break into regular shape.
Is it used for road aggregate?	No, it is not hard (strong) enough for aggregates.
For what other purpose might the limestone be used?	Limestone was burned to make quick lime. This was used for plaster, mortar, whitewash and antiseptic. Ground-up limestone was spread on fields to neutralise acid soils It was also used in local iron furnaces as a flux.

Now turn to look at the level floor of the quarry.

ACTIVITY SHEET 6 **Pupil Name .....**

Site B to C: – A close look at the Quarry floor (i)

Activity 7. Now that we have looked at the Jurassic limestones in the quarry faces let us look at the quarry floor.

Is the quarry floor made of the same yellowy coloured Jurassic limestone as the faces?	No.
Briefly describe the rock on the quarry floor.	Hard and grey in colour. It is also layered.
Is it older or younger than the Jurassic limestone? [You may have done an activity in school which will help you to answer]	The dark rock is older.
How can you tell?	It is/was underneath/below the Jurassic limestone.
Describe the surface of the older rock on the quarry floor. Is it Perfectly flat, OR Fairly flat, with small ridges OR Very bumpy?	Fairly flat, with small ridges.
What do you think this surface was in Jurassic times?	The sea bed.

Can you find these fossils on the quarry floor?

Jurassic Oysters

Rock bored by marine Jurassic worms (Site C)

ACTIVITY SHEET 7 **Pupil Name ……..**

Site B to C: – A close look at the Quarry floor (ii)

Activity 8. We are walking on a Jurassic sea bed. As we walk SE towards Site C we shall keep a look-out on the ancient sea floor.

Do you know of any shelly creatures that live in the sea on hard rock? Your teacher will help you!	Some fix themselves to rocks – e.g. oysters. Some bore holes in rocks and live in them – e.g. piddock
See if you can find any hollows about 6 cm by 3 cm, with oval shells in them, like oysters. Are they grouped together or separate?	Some are in groups, others are separate. [one area is marked on the map]
The best place to find animal borings is at the eastern edge of the quarry floor, at Site C. Have a look for some. They are usually about half a cm wide. Measure the length of one.	The length of the boring I measured is **__(varies around) 3** _____cm
Are they grouped together or separate?	Usually grouped together at this locality.
The animals which made the holes died and the holes filled with creamy mud which is now hard. In which period of geological time did this happen?	The Jurassic Period.

Now let us look at the hard grey rocks.

ACTIVITY SHEET 8 **Pupil Name .....**

Site C: – On the edge (i)

Activity 9. Circle site C on your map.

Carefully step over the edge of the quarry floor onto the grass and look at the hard grey rocks from the side. We have already decided that they are older than the Jurassic limestones because they lie below and underneath them.

Which TWO of these words best describe the hard grey rocks on the edge? **Layered; Jumbled up; Level, [horizontal]; Tilted sloping**]	Layered Tilted [sloping]
Is it made of bits cemented together? See if any rub off.	Yes it is made of bits cemented together (some may be fossils). The rock is too hard to rub them off.
You might be able to find fossil shells of sea creatures. What does this tell us about where these rocks were formed?	In the sea. Possibly corals, brachiopod shells, broken crinoid [sea lily] "stems" looking like polo mints.
Does the rock react with acid?	It fizzes - so it is a carbonate.
What does this tell you about the kind of rock it is?	Limestone, but not exactly the same as the other one. It is older, harder and darker.
With a water dropper, test the rock for porosity.	It is not porous. However, some water may go down cracks in the limestone, so this makes it permeable – but not porous.
We can see that these layers or beds of rock are tilted. Some are slightly harder than others. Geologists use the term "dip" to describe the angle of slope. Are they all tilted [dipping] the same way? In which direction do they dip?	All dip the same way, to NNW

Activity 10. We have found out that these older rocks also formed under the sea. The fossils found here are different and tell us that this was about 340 million years ago, in the early part of the Carboniferous Period. The rocks are now above sea level, are tilted and broken by cracks called joints.

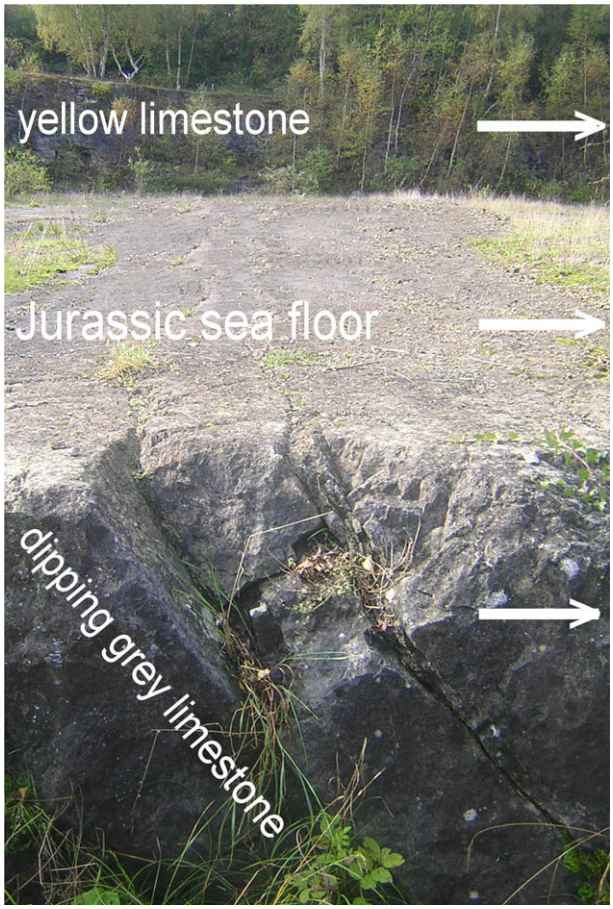
How do you think all this happened? Earth movements over millions of years uplifted the rocks, tilted and broke them.

ACTIVITY SHEET 9 **Pupil Name .....**

Site C: – On the edge (ii)
Activity 11.
Match the photo below to the view at Site C. On the photo write on the following labels in the correct places:
a. grey limestone **b. yellowish limestone** **c. Jurassic sea bed**

Draw arrows to link each part of the photograph to the box with the correct description at the side.

Try to work out the time gap between the 340 Million year old Carboniferous limestone and the 160 Million year old Jurassic limestone.



Horizontal beds of 160 million year old Jurassic limestone.

The 160 million year old eroded surface between the two rock types.

Beds of 340 million year old Carboniferous limestone dipping to NNW.

Try to work out the time gap between the 340 Million year old Carboniferous limestone and the 160 Million year old Jurassic limestone

340 – 160 = 180 Million years time gap.

ACTIVITY SHEET 10 **Pupil Name .....**

Site C: – On the edge (iii)

Activity 12.

We have already mentioned uses of the Jurassic limestone. If Whatley Quarry is part of your visit you will find out a lot about the uses of Carboniferous limestone.

What is it about the Carboniferous limestone that makes it so useful for road aggregate and railway ballast?	It is hard and non-porous.
What else might the Carboniferous limestone be used for?	As a building stone. Burned to make cement. (Cement is added to sand & gravel to make concrete etc.)
How is limestone moved from **Whatley Quarry**?	Mostly by railway to places all over southern England
What are the benefits of using this type of transport?	Cheaper than road for very bulky loads. Road transport difficult and dangerous along country roads. More environmentally friendly, keeping traffic off roads & uses less fuel.

We can now look at how plants are colonising the quarry, by heading SW to site D.

ACTIVITY SHEET 11 **Pupil Name .....**

Site D: – Plants taking over
Activity 13.
Circle Site D on your map.
At Site B we mentioned the way that soil develops and plants colonise the exposures of rock. We can investigate this further at this southern end of the quarry.

Before you get to the faces you will see patches of wet ground on top of the Carboniferous limestone. Why doesn't the water soak into the rock?	Carboniferous limestone is not porous.
What plants can you identify that live in these wet conditions?	Mosses, lichen, some grasses.
As you walk closer to the faces there is usually a gentle slope of broken rock material that is turning into soil. What name do we give to this slope of broken rock material?	Scree.
What is this soil made of?	Bits of limestone, sand & clay. Living and decaying plants and animals. Water & air.
What rock are the quarry faces made of?	Jurassic limestone [oolitic].
What plants can you identify growing on the rock faces and in the joints?	Mosses, lichen etc.
What other plants can you identify in this part of the quarry?	Silver birch, oak etc as saplings. Shrubs, grasses, various wild flowers.
How have these plants got here?	Seed dispersal by wind, birds & other animals.
Investigate the leaf litter for minibeasts and larger animals. What can you find?	Earthworms, insects etc. (and possibly many others).
Compare the thickness of the trees with most of the trees above the edge of the quarry.	Those above the edge tend to be larger.
Suggest a reason for this.	Those above are older & were alive before the quarrying finished.
Why is this part of the quarry damper and shadier than the rest? A compass will give you a clue.	Southern end faces north, gets less direct sunlight than the rest of the quarry.

Look out for the original soil level before quarrying began. Your teacher might collect a soil sample from here to investigate back at school. Before we return to the parking area make sure that you have completed your activity sheets and not left anything behind.

ACTIVITY SHEET 12 **Pupil Name .....**

Tedbury Camp - Summary pupil activity (i) (optional replacement for activities 3 to 13)

On our visit to Tedbury Camp Quarry we have found out a lot about the rocks beneath our feet.

Describe the younger rock, formed in Jurassic times.	It is yellow, made of pieces cemented together and has fossils in it.
Are the rocks jumbled up or layered?	They are layered.
Are they flat or tilted?	They are nearly flat.
Describe the older rock, formed in Carboniferous times.	It is dark in colour, it is not porous and contains fossils.
Are these older rocks jumbled up or layered?	They are layered.
Are they flat or tilted?	They are tilted.
Although they look different both rocks are mostly made of lime mud. What rock type are they?	They are both limestones.
You might have found shells of ancient sea creatures. What are ancient remains of animals and plants called?	They are called fossils.
Your answers will help you to decide where these rocks were formed. Were they formed on land, or in the sea?	They were formed in the sea.
Sand, lime mud and clay are types of sediment. This word gives a clue to the name given to a large group of rocks, including sandstones, mudstones and limestones. What is this name?	Sedimentary rocks.
Both the limestones were formed on the sea bed millions of years ago. What has happened to them since they were formed?	They have been tilted and lifted up by earth movements.
The quarry floor is a boundary between the Carboniferous limestone and the Jurassic limestone. How many million years are missing?	340 - 160 = 180 million years.

ACTIVITY SHEET 13 **Pupil Name .....**

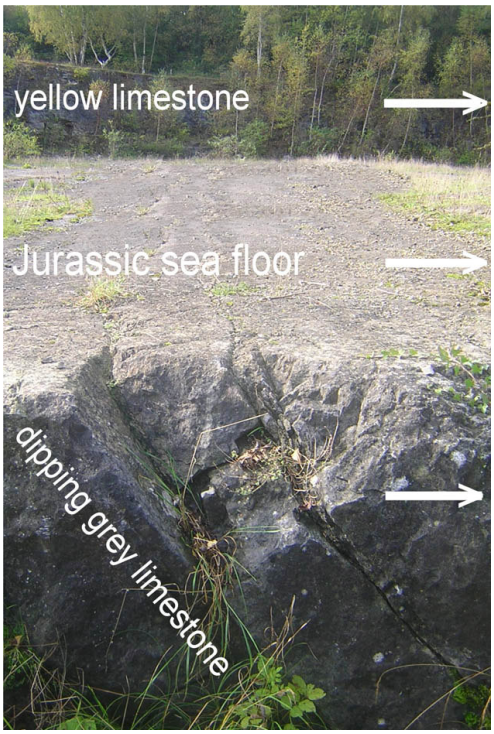
Tedbury Camp - Summary pupil activity (ii)
(optional replacement for activities 3 to 13)

The two limestones have been quarried in the area for hundreds of years. What are the main uses made of each type?	Yellow: Limestone was burned to make quick lime. This was used for plaster, mortar, whitewash and antiseptic. Ground-up limestone was spread on fields to neutralise acid soils. It was also used in local iron furnaces as a flux. Dark: Road aggregate and railway ballast.

On the photograph below of the edge of the quarry write on the following labels:

a) grey limestone
b) yellowish limestone
c) Jurassic sea bed

Draw arrows on the picture to link each part of the photograph to the box at the side with the correct description.



Site C

Horizontal beds of 160 million year old Jurassic limestone.

The 160 million year old eroded surface between the two rock types.

Beds of 340 million year old Carboniferous limestone tilted/dipping to NNW.