# Biology PAG 3: Sampling techniques

# Combined Science PAG B2: Sampling techniques

# Suggested Activity 2: Investigating the differences in habitats using ecological sampling techniques

## Instructions and answers for teachers & technicians

These instructions cover the learner activity section which can be found on [page 14](#_Learner_Activity). This Practical activity supports OCR GCSE Biology.

**When distributing the activity section to the learners either as a printed copy or as a Word file you will need to remove the teacher instructions section.**

|  |
| --- |
| This is a **suggested** practical activity that can be used as part of teaching the GCSE (9-1) Gateway Science (A) and Twenty First Century Science (B) specifications.  These are **not controlled assessment tasks**, and there is **no requirement to use these particular activities**.  You may modify these activities to suit your learners and centre. Alternative activities are available from, for example, [Royal Society of Biology](https://www.rsb.org.uk/education/teaching-resources/secondary-schools), [Royal Society of Chemistry](http://www.rsc.org/learn-chemistry), [Institute of Physics](http://www.iop.org/education/teacher/resources/index.html), [CLEAPSS](http://science.cleapss.org.uk/) and [publishing companies](https://global.oup.com/education/content/secondary/key-issues/gcse_science_2016/?region=uk), or of your own devising.  Further details are available in the [specifications](http://www.ocr.org.uk/science) (Practical Skills Topics), and in these [videos](https://www.youtube.com/playlist?list=PLBD9B84FF4BD54AA4). |

**OCR recommendations:**

**Before carrying out any experiment or demonstration based on this guidance, it is the responsibility of teachers to ensure that they have undertaken a risk assessment in accordance with their employer’s requirements, making use of up-to-date information and taking account of their own particular circumstances. Any local rules or restrictions issued by the employer must always be followed.**

**CLEAPSS resources are useful for carrying out risk-assessments: (**<http://science.cleapss.org.uk>**).**

**Centres should trial experiments in advance of giving them to learners. Centres may choose to make adaptations to this practical activity, but should be aware that this may affect the Apparatus and Techniques covered by the learner.**

### Introduction

On first impressions this PAG appears to favour centres in a more rural location. However the term habitat, when applied correctly, does include many locations that can be applied to a more urban centre (e.g. brownfield land and urban). Indeed learners could be made aware that they share their home with a rich variety of creatures that they could sample (<https://www.lewisham.gov.uk/myservices/environment/pestcontrol/Documents/InsectIdentificationSheet.pdf>).

A suitable starting point to identify what you can find in each habitat can be found here: <https://www.wildlifetrusts.org/habitats>. It may be useful for centres with different habitats to link-up so data can be exchanged and compared.

This topic should not be unduly difficult practically. It is better that the centre uses all of the sampling techniques that they have the equipment for.

### DfE Apparatus and Techniques covered

The codes used below match the OCR Practical Activity Learner Record Sheet ([**Biology**](http://www.ocr.org.uk/Images/-295601-gcse-biology-learner-record-sheet.doc) / [*Combined Science*](http://www.ocr.org.uk/Images/304431-gcse-combined-science-learner-record-sheet.doc)) and Trackers ([**Biology**](http://www.ocr.org.uk/Images/323480-gcse-biology-practical-tracker.zip) / [*Combined Science*](http://www.ocr.org.uk/Images/323483-gcse-combined-science-practical-tracker.zip)) available online. **There is no requirement to use these resources.**

**1** *[1]***:** Use of appropriate apparatus to make and record a range of measurements accurately, including: **i**[*i*]) length**; v**[*v*]) temperature**; vi**[*vi*]) volume of liquids**; viii**[*ix*]) pH

**5** *[5]*: Measurement of rates of reaction by a variety of methods including: iii) colour change of indicator

**6** *[6]*: Application of appropriate sampling techniques to investigate the distribution and abundance of organisms in an ecosystem via direct use in the field

### Aims

To become familiar with the methods of sampling biotic and abiotic factors in a habitat

To compare habitats

To collect data in a non-laboratory situation

To analyse data

To evaluate the effectiveness of sampling methods

### Intended class time

This activity will take 60 minutes.

### Links to Specifications:

### Gateway

B4.1f explain how abiotic and biotic factors can affect communities to include: temperature, light intensity, moisture level, pH of soil, predators, food

B6.1a explain how to carry out a field investigation into the distribution and abundance of organisms in a habitat and how to determine their numbers in a given area sampling techniques (random and transects, capture-recapture), use of quadrats, pooters, nets, keys and scaling up methods

### Twenty First Century

B3.4.1. explain how some abiotic and biotic factors affect communities, including environmental conditions, toxic chemicals, availability of food and other resources, and the presence of predators and pathogens

B3.4.2. describe how to carry out a field investigation into the distribution and abundance of organisms in an ecosystem and explain how to determine their numbers in a given area

B3.4.3. in the context of data related to organisms within a population:

a) calculate arithmetic means

b) use fractions and percentages

c) plot and draw appropriate graphs selecting appropriate scales for the axes

d) extract and interpret information from charts, graphs and tables

### Mathematical Skills covered

Understand the principles of sampling as applied to scientific data

Find arithmetic means

Understand the terms mean, mode and median

### Gateway working scientifically references covered

WS1.3a presenting observations and other data using appropriate method to include descriptive, tabular diagrammatic and graphically

WS1.3c carrying out and representing mathematical and statistical analysis statistical analysis to include arithmetic means, mode, median

WS1.3h identifying potential sources of random and systematic error

WS1.3i communicating the scientific rationale for investigations, methods used, findings and reasoned conclusions presentations through paper-based presentations using diagrammatic, graphical, numerical and symbolic forms

WS2a carry out experiments due regard to the correct manipulation of apparatus, the accuracy of measurements and health and safety considerations, and following written instructions

WS2b make and record observations and measurements using a range of apparatus and methods keeping appropriate records

WS2c presenting observations using appropriate methods to include descriptive, tabular diagrammatic and graphically

WS2d communicating the scientific rationale for investigations, methods used, findings and reasoned conclusions presentations through paper-based and electronic reports and presentations using verbal, diagrammatic, graphical, numerical and symbolic forms

### Twenty First Century IaS references covered

IaS1.5 suggest an appropriate sample size and/or range of values to be measured and justify the suggestion

IaS2.1 present observations and other data using appropriate formats

IaS2.9. in a given context evaluate data in terms of accuracy, precision, repeatability and reproducibility, identify potential sources of random and systematic error, and discuss the decision to discard or retain an outlier

IaS2.10. evaluate an experimental strategy, suggest improvements and explain why they would increase the quality (accuracy, precision, repeatability and reproducibility) of the data collected, and suggest further investigations

### Essential equipment (per group)

Random sampling

* Pooter
* Quadrant
* Tape measure at least 10 m in length (x2)
* Key – appropriate to the habitat being studied
* Random number generator/table
* Umbrella or sheet
* Method of recording data (pencil/paper)
* Nets (sweep/butterfly)
* 15 cm or greater nail
* Thermometer
* Soil pH testing kit – following manufacturer’s instructions

### Supplementary equipment (per group)

Please note that the following equipment can be used to extend knowledge of sampling techniques. If the centre has the following then they can use/demonstrate this to their students. If the centre does not have this equipment then it can be demonstrated by photograph etc.

* Tullgren funnel
* Pin quadrant

### Method

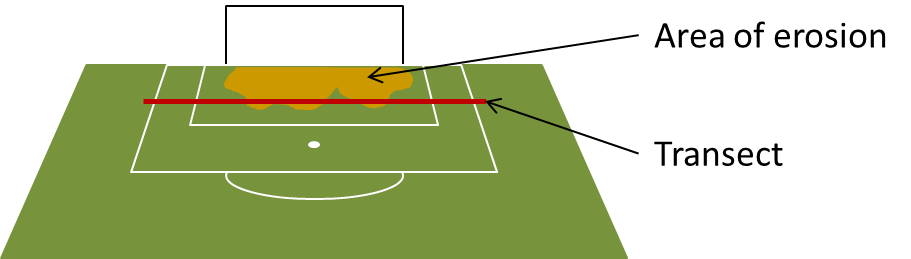
**Identifying the two sampling area:**

If you are lucky to be in a centre that has a variety of habitats then this should pose no problem. If you choice is limited then there are many ways to overcome this:

* A visit could be used to compare different habitats.
* Collaboration could be done between two centres with different habitats. Care would have to be taken to ensure that a standard operating procedure is done at both centres.
* If the centre has an ‘activities week’ e.g. at an outwards bounds course, then the staff at these facilities are usually more than happy to accommodate a request to do some ecological sampling.

The choice of site needs to be one where a difference can be found. These could include:

* two distinct areas e.g. grassland and urban
* a site before and after an event e.g. mowing, coppicing etc.
* a site where there is a difference e.g. where there is obvious succession (e.g. a sand dune) or erosion e.g. across a goal mouth of a football pitch (see figure) or across a footpath.

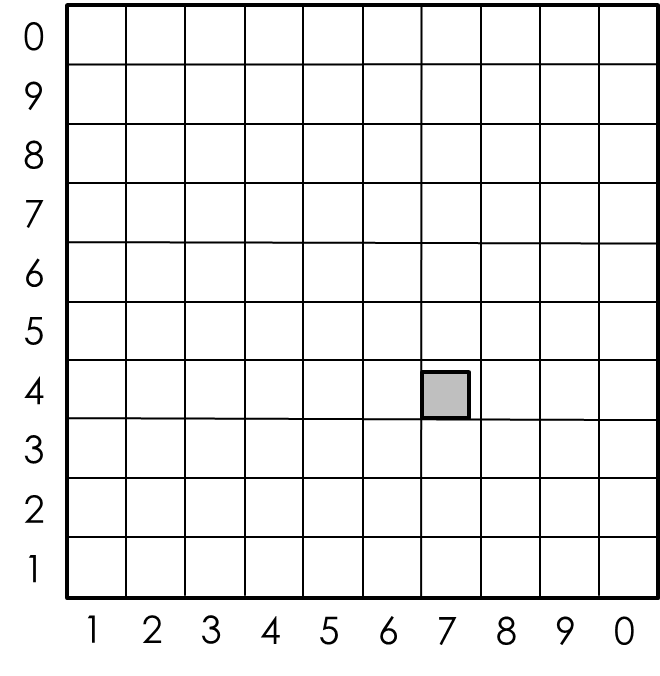


### Quadrants

**Setting a quadrant:**

At each site learners will need to do the following:

* Place the two tapes at right angles to each other on the sample site.
* Point out to the learners that these tapes represent a large graph.
* Following the instructions on the random number table for two digit random numbers (<http://www.nist.gov/pml/wmd/pubs/upload/AppenB-HB133-05-Z.pdf>). Alternatively use a calculators random number generator (e.g. on an iPhone scientific calculator the Rand button). The number generated by my calculator was 0.746850853643032; ignore the 0. Then take the 7 and 4.
* Using the numbers obtained from the random number generator position the quadrat at 7 m on the x-axis and 4 on the y-axis.



NOTE: IF the transect is not a square metre, then it will need to be positioned in the same place at each sampling site e.g. corner in bottom left of the metre square (as shown above).

NOTE: It is possible to get more than one group on each grid. If two groups have the same coordinates then they can share the data.

**Estimating the coverage**

This depends on the type of quadrat used

* For a frame quadrat (just a square) estimate the percentage cover visually.
* For a grid quadrat percentage frequency can be calculated by counting the number of squares containing each species.

**Measuring abiotic factors**

Learners could use the opportunity to test abiotic factors at each sampling location. Abiotic factors that could be tested could be:

* Light intensity (with a lux-meter)
* Compaction (how far can a 15 cm nail be pushed into the ground)
* Temperature (thermometer can be inserted into the hole produced by the nail but for reasons of safety ensure that it is guarded when equilibrating and is immediately removed after the reading)
* Moisture content (using a moisture probe, these can be unreliable but can provide a point of evaluation)
* pH of the soil using either a soil pH test kit – following manufacturer’s instructions

### Transects

There are two main types of transect: line and belt (sampling along a line or tape measure or sampling an area along a line e.g. with a quadrat).

There are two main types of sampling techniques used: continuous and interrupted (along the entire length of the line or at various positions along the line respectively).

Simply decide on the method to be used and then sample appropriately.

### Pooter

In learners hands pooters are not a good method of random sampling. They tend to think this is open season on insects. They get sight of an insect and the poor thing has no chance. The slower the insect, the more chance it has of being captured (woodlice and ants can therefore be abnormally be represented in the sample). Also learners do not tend to want to suck up spiders and these are poorly represented in the sample.

A better way is to shake a bush/tree branch into an upturned umbrella/sheet and allow the learners to then collect all the insects that fall into it.

NOTE: Please ensure that the students always have the correct pooter tube in their mouths when sampling; failure to do this will result in a learner with a lung-full of insects.

### Notes

The random placing of the quadrat is essential. It is not suitable (or at all advisable) to use the method of spinning and throwing the quadrat behind you.

The methods mentioned here are not infallible as random numbers are difficult to generate. Agricultural/horticultural scientists do use a variety of methods to ensure the samples are random including the randomised block design to reduce variability.

### Technician Notes

For this practical the teacher will require for a class of 30:

* 15 Pooters (for instructions on how to make one: <http://www.discoverwildlife.com/british-wildlife/your-garden/how-make-pooter>)
* 15 Quadrats
* 6 Tape measure at least 10 m in length (x2)
* 15 Keys – appropriate to the habitat being studied
* 15 Random number generators/tables (A suitable table is here: <http://www.nist.gov/pml/wmd/pubs/upload/AppenB-HB133-05-Z.pdf> alternatively a scientific calculator’s random number function can be used)
* An umbrella or sheet
* Method of recording data (pencil/paper)
* 3 Nets (sweep/butterfly)
* 15 nails (15 cm or greater)
* 15 Thermometers
* Soil pH testing kit - these can be purchased from most garden centres or can be made simply using the principals described in the following link: <http://preparednessmama.com/testing-your-soil-ph-without-a-kit/>.

If the centre has the following they may be used in the lesson:

* Tullgren funnel
* Pin quadrat

### Quiz questions - answers

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| **1.** | A sycamore tree has 10,000 leaves. Using a pooter John samples 10 leaves to estimate the number of greenfly on the tree.   | **Results from pooter** | | | --- | --- | | **Leaf number** | **Number of flies** | | 1 | 10 | | 2 | 7 | | 3 | 8 | | 4 | 12 | | 5 | 0 | | 6 | 20 | | 7 | 4 | | 8 | 2 | | 9 | 6 | | 10 | 9 | |  |  | | |  |
|  | **(a)** | Work out the average number of greenfly on each leaf.  **[2 marks]** |  |
|  |  | 10+7+8+12+0+20+4+2+6+9=78 🗸  78÷10=7.8 🗸 |  |

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|  | **(b)** | Estimate how many greenfly on the tree.  **[1 mark]** |  |
|  |  | 7.8x10,000=78,000 🗸 |  |

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| **2.** | | **Results from the school field** | | | --- | --- | | **Quadrat number** | **Daisy count** | | 1 | 15 | | 2 | 7 | | 3 | 12 | | 4 | 0 | | 5 | 10 | | 6 | 6 | | 7 | 17 | | 8 | 5 | | 9 | 11 | | 10 | 7 |   Oscar decides to estimate the number of daisy plants on the school field. Instead of crawling on his hands and knees and counting each plant, he throws a quadrat ten times and counts the number of plants in each quadrat. He gets the following results:  The quadrat has sides of length 0.5 m.  The school field measures 120 m x 200 m. | |  |
|  | **(a)** | Calculate the mean number of daisies counted in the sampling.  **[2 marks]** |  |
|  |  | 15+7+12+0+10+6+6+17+5+11+7=90 🗸  90÷10=9 🗸 |  |

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|  | **(b)** | Estimate the total number of daisy plants on the school field.  **[3 marks]** |  |
|  |  | 9x4=36 🗸  120x200=24,000 🗸  36x24,000=864,000 🗸 |  |

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| --- | --- | --- | --- |
|  | **(c)** | What assumptions have you made in question 2?  **[1 mark]** |  |
|  |  | That the daisy population is evenly spread across the field 🗸 |  |

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|  | **(d)** | Suggest ways to increase the accuracy of Oscar’s results.  **[2 marks]** |  |
|  |  | The method he used was not random therefore use a better procedure to place the quadrat. 🗸  Increase the number of samples taken 🗸 |  |

### Document updates

v1 Published on the qualification pages

v1.1 January 2017 Consolidated labelling and formatting of activities

v1.2 February 2017 Updated to include further measurement techniques

v1.3 June 2021 Update to meet digital accessibility standards



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# Biology PAG 3: Sampling techniques

# Combined Science PAG B2: Sampling techniques

# Suggested Activity 2: Investigating the differences in habitats using ecological sampling techniques

## Learner Activity

### Investigating the differences in habitats using ecological sampling techniques

### Introduction

On first impressions this activity appears to favour centres in more rural locations. However, even at home there is a variety of animals you could sample. Besides the obvious (e.g. pets) you share your home with a number of other animals (<https://www.lewisham.gov.uk/myservices/environment/pestcontrol/Documents/InsectIdentificationSheet.pdf>).

The term habitat when used correctly does include many locations that can be applied to a more urban location (e.g. brownfield land and the urban habitat) these could include the schoolyard, a graveyard etc.

A suitable starting point to identify what you can find in each habitat can be found here: <https://www.wildlifetrusts.org/habitats>. It may be useful for you to compare your data to a different centre with different habitats to link up so data can be exchanged and compared.

### Aims

To become familiar with the methods of sampling biotic and abiotic factors in a habitat

To compare habitats

To collect data in a non-laboratory situation

To analyse data

To evaluate the effectiveness of sampling methods

### Essential equipment (per group)

Random sampling

* Pooter
* Quadrant
* Tape measure at least 10 m in length (x2)
* Key – appropriate to the habitat being studied
* Random number generator/table
* Umbrella or sheet
* Method of recording data (pencil/paper)
* Nets (sweep/butterfly)
* 15 cm or greater nail
* Thermometer
* Soil pH testing kit

### Supplementary equipment (per group)

Please note that the following equipment may be demonstrated to you to extend your knowledge of sampling techniques.

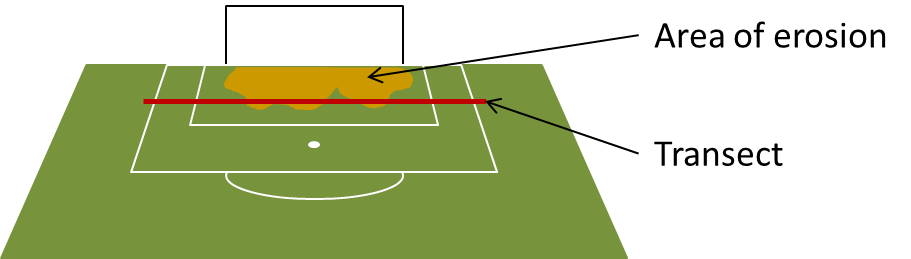
* Tullgren funnel
* Pin quadrant

### Method

Identifying the two sampling areas:

### The choice of site needs to be one where a difference can be found. These could include:

* two distinct areas e.g. grassland and urban etc.
* a site before and after an event e.g. mowing, coppicing etc.
* a site where there is a difference e.g. where there is obvious succession (e.g. a sand dune) or erosion (e.g. across a goal mouth of a football pitch or across a footpath).

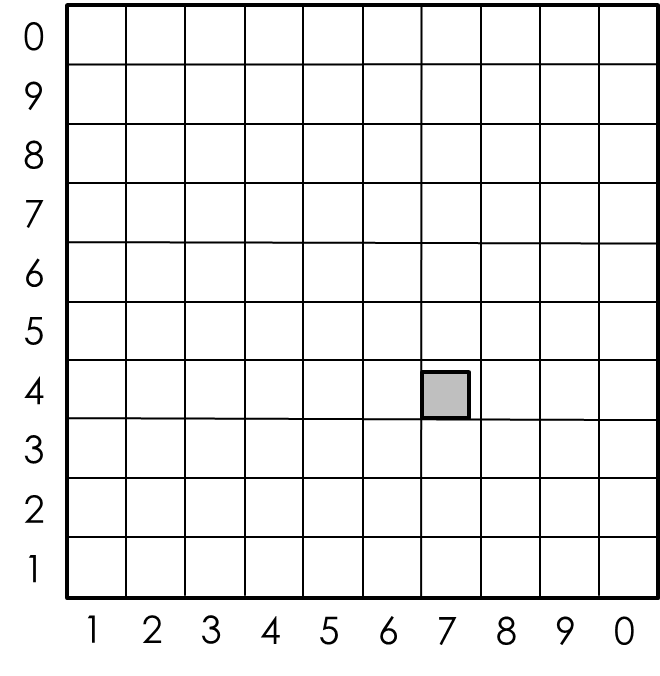


### Quadrants

**Setting a quadrant:**

At each site learners will need to do the following:

* Place the two tapes at right angles to each other on the sample site.
* These tapes represent a large graph.
* Following the instructions on the random number table for two digit random numbers (<http://www.nist.gov/pml/wmd/pubs/upload/AppenB-HB133-05-Z.pdf>). Alternatively use a calculators random number generator (e.g. on an iPhone scientific calculator the Rand button). The number generated by my calculator was 0.746850853643032; ignore the 0. Then take the 7 and 4.
* Using the numbers obtained from the random number generator position the quadrat at 7 m on the x-axis and 4 on the y-axis.



NOTE: IF the transect is not a square metre, then it will need to be positioned in the same place at each sampling site e.g. corner in bottom left of the metre square (as shown above).

NOTE: It is possible to get more than one group on each grid. If two groups have the same coordinates then you can share the data.

**Estimating the coverage**

This depends on the type of quadrat used

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* For a grid quadrat percentage frequency can be calculated by counting the number of squares containing each species.

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Learners could use the opportunity to test abiotic factors at each sampling location. Abiotic factors that could be tested could be:

* Light intensity (with a lux-meter)
* Compaction (how far can a 15 cm nail be pushed into the ground)
* Temperature (thermometer can be inserted into the hole produced by the nail but for reasons of safety ensure that it is guarded when equilibrating and is immediately removed after the reading)
* Moisture content (using a moisture probe, these can be unreliable but can provide a point of evaluation)
* pH of the soil using either a soil pH probe or soil pH test kit.

### Transects

There are two main types of transect: line and belt (sampling along a line or tape measure or sampling an area along a line e.g. with a quadrat).

There are two main types of sampling techniques used: continuous and interrupted (along the entire length of the line or at various positions along the line respectively).

Simply decide on the method to be used and then sample appropriately.

### Pooter

Pooters are not a good method of random sampling. Users of pooters tend to get the sight of an insect and then the poor thing has no chance. The slower the insect, the more chance it has of being captured (woodlice and ants can therefore be abnormally be represented in the sample). Also people do not tend to want to suck up spiders and these are poorly represented in the sample.

A better way is to shake a bush/tree branch into an upturned umbrella/sheet and then collect all the insects that fall into it.

NOTE: Please ensure that you have the correct pooter tube in your mouth when sampling; failure to do this will result in a lung-full of insects.

Also be aware of the size of the tubes being used. For a typical pooter it is not advised to try and sample a convolvulus hawkmoth with a pooter. It’s wingspan of 12cm makes it wholly unsuitable – consider using a net.

Nets

Nets must not be used to chase the ‘target’ insect all over the sampling site. This would not be a random sample, but more a hunt. When using a net a set distance is ‘swept’ (e.g. 100 m). This means that the net is held at a specific height and a set length is walked. You should not change the position of the net during the sample to catch an insect that is not in the swept area.

After the sample the net can be examined. It may be useful to use a pooter to collect the smaller animals in the sample.

### Notes

The random placing of the quadrat is essential. It is not suitable (or at all advisable) to use the method of spinning and throwing the quadrat behind you.

The methods mentioned here are not fool proof as random numbers are difficult to generate. Agricultural/horticultural scientists do use a variety of methods to ensure the samples are random including the randomised block design to reduce variability.Quiz - test your knowledge and understanding

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| **1.** | A sycamore tree has 10,000 leaves. Using a pooter John samples 10 leaves to estimate the number of greenfly on the tree.   | **Results from pooter** | | | --- | --- | | **Leaf number** | **Number of flies** | | 1 | 10 | | 2 | 7 | | 3 | 8 | | 4 | 12 | | 5 | 0 | | 6 | 20 | | 7 | 4 | | 8 | 2 | | 9 | 6 | | 10 | 9 | |  |  | | |  |
|  | **(a)** | Work out the average number of greenfly on each leaf.  **[2 marks]** |  |
|  |  |  |  |

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| --- | --- | --- | --- |
|  | **(b)** | Estimate how many greenfly on the tree.  **[1 mark]** |  |
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| **2.** | | **Results from the school field** | | | --- | --- | | **Quadrat number** | **Daisy count** | | 1 | 15 | | 2 | 7 | | 3 | 12 | | 4 | 0 | | 5 | 10 | | 6 | 6 | | 7 | 17 | | 8 | 5 | | 9 | 11 | | 10 | 7 |   Oscar decides to estimate the number of daisy plants on the school field. Instead of crawling on his hands and knees and counting each plant, he throws a quadrat ten times and counts the number of plants in each quadrat. He gets the following results:  The quadrat has sides of length 0.5 m.  The school field measures 120 m x 200 m. | |  |
|  | **(a)** | Calculate the mean number of daisies counted in the sampling.  **[2 marks]** |  |
|  |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
|  | **(b)** | Estimate the total number of daisy plants on the school field.  **[3 marks]** |  |
|  |  |  |  |

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| --- | --- | --- | --- |
|  | **(c)** | What assumptions have you made in question 2?  **[1 mark]** |  |
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|  |  |  |  |
| --- | --- | --- | --- |
|  | **(d)** | Suggest ways to increase the accuracy of Oscar’s results.  **[2 marks]** |  |
|  |  |  |  |

### DfE Apparatus and Techniques covered

If you are using the OCR Practical Activity Learner Record Sheet ([**Biology**](http://www.ocr.org.uk/Images/-295601-gcse-biology-learner-record-sheet.doc) / [*Combined Science*](http://www.ocr.org.uk/Images/304431-gcse-combined-science-learner-record-sheet.doc)) you may be able to tick off the following skills:

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| **Biology** | | | |  | ***Combined Science*** | | | |
| 1–i | 1–v | 1–vi | 1–viii |  | *1–i* | *1–v* | *1–vi* | *1–ix* |
| 5–iii | 6 |  |  |  | *5–iii* | *6* |  |  |