STUDY COMMENTARY FOR UNIT 4:
PRACTICAL WORK IN SCIENCE

ATTAINMENT TARGET ADDRESSED IN
UNIT 4: AT1  3

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ATTAINMENT TARGET
ADDRESS IN UNIT 4: AT1

ATTAINMENT TARGET 1: EXPLORATION OF SCIENCE

Pupils should develop the intellectual and practical skills that allow them to explore the world of science and to develop a fuller understanding of scientific phenomena and the procedures of scientific exploration and investigation. This work should take place in the context of activities that require a progressively more systematic and quantified approach, which draws upon an increasing knowledge and understanding of science. The activities should encourage the ability to:

1. plan, hypothesize and predict
2. design and carry out investigations
3. interpret results and findings
4. draw inferences
5. communicate exploratory tasks and experiments.

STATEMENTS OF ATTAINMENT

LEVEL 1

Pupils should:

a. observe familiar materials and events in their immediate environment, at first hand, using their senses
b. describe and communicate their observations, ideally through talking in groups or by other means, within their class.

LEVEL 2

Pupils should:

a. ask questions and suggest ideas of the ‘How ...?’, ‘Why ...?’ and ‘What will happen if ...?’ variety
b. identify simple differences, for example hot/cold, rough/smooth
c. use non-standard and standard measures, for example hand-spans and rulers
d. list and collate observations
e. interpret findings by associating one factor with another, for example the pupils' perception at this level that ‘light objects float’, ‘thin wood is bendy’
f. record findings in charts, drawings and other appropriate forms.

LEVEL 3

Pupils should:

a. formulate hypotheses, for example ‘this ball will bounce higher than that one’
b. identify, and describe, simple variables that change over time, for example growth of a plant
c distinguish between a ‘fair’ and an ‘unfair’ test
d select and use simple instruments to enhance observations, for example a stop-clock or hand lens
e quantify variables, as appropriate, to the nearest labelled division of simple measuring instruments, for example a rule
f record experimental findings, for example in tables and bar charts
g interpret simple pictograms and bar charts
h interpret observations in terms of a generalized statement, for example ‘the greater the suspended weight, the longer the spring’
i describe activities carried out by sequencing the major features.

LEVEL 4

Pupils should:
a raise questions in a form which can be investigated
b formulate testable hypotheses
c construct ‘fair tests’
d plan an investigation where the plan indicates that the relevant variables have been identified and others controlled
e select and use a range of measuring instruments, as appropriate, to quantify observations of physical quantities, such as volume and temperature
f follow written instructions and diagrammatic representations
g carry out an investigation with due regard to safety
h record results by appropriate means, such as the construction of simple tables, bar charts, line graphs
i draw conclusions from experimental results
j describe investigations in the form of ordered prose, using a limited technical vocabulary.

LEVEL 5

Pupils should:
a use concepts, knowledge and skills to suggest simple questions and design investigations to answer them
b identify and manipulate relevant independent variables, choosing appropriately between ranges, numbers and values
c select and use measuring instruments to quantify variables and use more complex measuring instruments with the required degree of accuracy, for example minor divisions on thermometers and force meters
d make written statements of the patterns derived from the data obtained from various sources.
PROGRAMMES OF STUDY

KEY STAGE 1: SUPPORTS ATTAINMENT TARGETS 1–6 AND 9–16; LEVELS 1–3

The abilities to communicate, to relate science to everyday life and to explore are essential elements of an initial experience of science.

Communication: Throughout their study of science, children should develop and use a variety of communication skills and techniques involved in obtaining, presenting and responding to information. They should also have the opportunity to express their findings and ideas to other children and their teacher, orally and also through drawings, simple charts, models, actions and the written word. They should be encouraged to respond to their teacher and to the reports and ideas of other children and become involved in group activities. In order to supplement their first-hand experience they should be introduced to books, charts, pictures, videos and to the use of computers.

Science in everyday life: As children begin to develop maturity and gain increasing knowledge and understanding, they should be given the opportunity to develop an awareness of the role and importance of science in everyday life. This awareness should be encouraged through visits. Children should use a variety of domestic and environmental contexts as starting-points for learning science.

Children should be encouraged to develop their investigative skills and understanding of science in the context of explorations and investigations largely of the ‘Do ...’, ‘Describe which ...’ and ‘Find a way to ...’ type, involving problems with obvious key variables which can be solved using a qualitative approach and which are set within the everyday experience of children.

These activities should:
- involve children and their teachers in promoting ideas and seeking solutions
- promote at first hand the exploration of objects and events
- encourage an appreciation of the need for safe and careful action
- encourage the sorting, grouping and describing of objects and events in their immediate environment, using their senses and noting similarities and differences
- increasingly encourage the development of non-standard, for example hand-spans, and simple standard measuring skills
- develop an understanding of the purposes of recording results and so encourage systematic recording, using appropriate methods, including block graphs and frequency charts
- encourage the interpretation of results
- develop reporting skills, ideally by talking, but also by other means, as appropriate.

KEY STAGE 2: SUPPORTS ATTAINMENT TARGETS 1–6 AND 9–16; LEVELS 2–5

The abilities to communicate, to relate science to everyday life and to explore are essential elements of a developing experience of science.

Communication: Children should have opportunities to continue to develop and use communication skills in presenting their ideas and in reporting their work to a range of audiences, including children, teachers, parents and other adults. In giving an account, either orally or in written form, they should be encouraged to present information in an ordered manner. They should be introduced to the conventions involved in using diagrams, tables, charts, graphs, symbols and models. Children should be given opportunities to participate in
small group discussions and they should be introduced to a limited range of books, charts and other sources from which they can gain information. Children should use the computer to store, retrieve and present their work.

**Science in everyday life:** As children begin to gain increasing knowledge and understanding, they should be given the opportunity to develop further an awareness of the role and importance of science in everyday life. This awareness might be developed through investigations or through case studies, secondary sources of information, or visits. Industrial contexts should be introduced, alongside those of domestic and environmental contexts, as starting-points for children’s work in science.

Children should be encouraged to develop their investigative skills and their understanding of science in activities which:

- promote the raising and answering of questions
- encourage a working understanding of safety and care
- are set within the everyday experience of children and provide opportunities to explore with increasing precision, where appropriate
- build on their existing practical skills within a given framework
- require the deployment of an increasingly systematic approach involving the identification and manipulation of obvious key variables.

These activities should:

- involve variables to be controlled in the development of a ‘fair test’
- involve problems which may be solved qualitatively, but which increasingly allow for some quantification of the variables involved
- encourage the formulation of testable hypotheses
- develop skills of using equipment and measurement, encouraging children to make decisions about when, what and how to measure
- encourage the systematic listing and recording of data, for example *in frequency tables and bar charts*
- encourage the searching for patterns in data
- encourage the interpretation of data, and evaluation against the demands of the problem
- encourage the development of written and/or oral reporting skills, as appropriate
- encourage the use of a limited technical vocabulary in communicating findings and ideas.
### TABLE 1 Levels of the attainment target addressed in Unit 4

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Note: a, b, c, etc. refer to the statements of attainment. For the complete statements, see pp. 3 to 6.
COMMENTARY GUIDE

This interdisciplinary Unit covers much basic material about scientific investigation. At first glance you may think that the text is an ‘easy read’ and so be tempted to skip through it in order to make a head start with the forthcoming Earth sciences Units, which may look rather inviting! We strongly advise you not to do this. Because of the importance of the science and scientific processes covered in this Unit, and because it deals with several points that crop up frequently throughout the Course and in your teaching of basic science, we recommend that you read it very carefully, except at points where we have indicated in these notes that you can safely skip material.

Much of this Unit relates to AT1, and this statement together with its associated levels and programmes of study is repeated on pp. 3 to 6.

1 INTRODUCTION

STUDY NOTES
You need only read this quickly.

TEACHING NOTES
By reading this Section you can begin to consider the various activities you should engage the children in, as they (with your help) experience and achieve AT1 Exploration of science.

KEY POINT
- Observation and the collection and analysis of data (carried out as part of practical activities) are central to a full understanding of science.

2 SCIENTIFIC INVESTIGATION

STUDY NOTES
This Section is very important. It is worth reading carefully—twice! Don’t be tempted to skip ITQ 1.

TEACHING NOTES
The weighting given to AT1 (the sole attainment target of profile component 1) of 50% in relation to the other attainment targets of key stages 1 and 2 gives an indication of the importance of scientific investigation to the teaching of science in the classroom.

You will probably already be involved in activities or investigations with the children, but your aim is to develop a systematic and rigorous approach to your participation in, and your teaching of, investigative work in science. It is
important for you to understand the differences between 'an investigation' and 'a scientific investigation' so that you can improve the quality and rigour of children's investigations.

Consider the experiment to measure the distance to the Moon introduced in Unit 2. In the process of doing this experiment and considering the accompanying Units, you also learnt about the Solar System (thus setting the experiment in context), mastered the mathematics involved in the experiment, gained an appreciation of the relative sizes of distant objects and subsequently gained an understanding of eclipses. So your investigative work was not done in isolation. This is what you must remember when designing investigations for the classroom.

Much of what was said about acquiring techniques and skills of measurement in Unit 2 applies equally to all the investigative work you will engage the children in. They will gain knowledge and understanding of scientific concepts by doing experimental work for themselves rather than by merely listening to you as their teacher. And just as the techniques and skills introduced in Unit 2 are woven into an exciting story of discovery about the Solar System, so you should plan to set the children 'hands-on' experiences fully in the context of their topic work, giving them an opportunity to practise and learn by doing as they go along.

The activities listed in levels 1 to 5 of AT1 can and should be incorporated into various types of scientific investigations. Only by actively engaging in such investigations will the children develop the appropriate intellectual and practical skills listed in the full range of attainment targets constituting the national curriculum. You will be required to develop and stage manage appropriate activities to allow a systematic development from straightforward observation and description (level 1) to a sophisticated, quantitative approach (levels 4 and 5).

Presenting the children with a logical sequence of experiences in investigative work in science requires meticulous planning. To begin with you need to establish clearly in your own mind how to plan experiments, develop hypotheses, make predictions and carry out experiments, and how to interpret results and findings. To give you a good grounding in this, in Section 5 you are provided with such a plan for the Moon experiment. The next stage involves working out how investigations can be organized in the classroom, where they provide the means for the children to test their ideas and solve problems by executing one or more of the following steps.

MAKING OBSERVATIONS

Encourage the children to look very carefully at things in order to discover more about them. Think about the most appropriate types of observations you might direct them towards. In some instances these will be qualitative in nature—observations that do not require measurement, e.g. taste, colour. Alternatively the may be quantitative—observations that do require measurement, e.g. length, volume, mass, time.

PREDICTING

Ask the children to suggest what they think will happen in the investigation.

DEVELOPING A HYPOTHESIS

This involves the children in suggesting an explanation for their observations. Encourage them to make a lot of responses at this stage.

TESTING IDEAS OR HYPOTHESES

The children will need and want to test their predictions and hypotheses to find out whether they are true. Their tests have to be fair in order that the results are meaningful. To begin with they will need a great deal of help to establish the
controlled conditions necessary for fair testing. Investigations 1 and 2 provide two examples to present to the children for discussion.

Alternatively, when children are involved in investigative work, you should introduce the technique of fair testing by questioning their methods and results and using their responses to help them develop a more rigorous attitude—i.e. a scientific approach to investigative work.

**INVESTIGATION 1: A FAIR RACE?**

We need to design a test to show which of three people can run 50 m in the fastest time. Ask the children to imagine that one runner (A) is blindfolded, another (B) has his legs tied loosely together, while the third (C) is free to run unhampered. You can then debate whether or not this is a fair test. You may wish to present the children with the times achieved in this hypothetical race by runners A, B and C, e.g. 31 s, 21 s and 8 s respectively. You can then discuss what these results tell you about the running abilities of the athletes! The children should arrive at the conclusion that similar conditions have to be in force for all runners in order to establish who can run the 50 m in the fastest time.

**INVESTIGATION 2: RATES OF COOLING—A FAIR TEST?**

We wish to investigate the rate of cooling of a quantity of water under different environmental conditions. The investigation involves boiling water in a kettle and then pouring some into each of four beakers. One beaker is placed in a fridge, one in a sunny area of the playground, one in the classroom and one in a shady spot in the playground. The temperature of the water is measured after a period of time has elapsed. Ask the children to give you suggestions for ways in which the test might not be fair, for example:

- the beakers might be different shapes (with different-sized apertures)
- the beakers might be made of different materials
- different amounts of water might be poured into the beakers
- the beakers might be left for varying intervals of time before the temperature of the water is tested.

Examples such as these demonstrate that to devise a fair test it is necessary to anticipate which conditions may affect a hypothesis and then to control them by deliberately allowing only one variable to change at a time. No other variable must be allowed to change. You should encourage the children to discuss why this is important. The outcome of the discussion should be the realization that if they change more than one variable at a time they will not know how to explain their results, because they will not know which variable has caused the result. Instil in them the general rule: change only one variable at a time.

Modelling is helpful in this context since the model generally simplifies the actual problem being studied, by isolating and displaying only certain properties of the real situation. Thus the number of variables is reduced to one or two. Refresh your memory of scientific modelling by looking back at the example given in the Study Commentary for Unit 1 of acting out planetary motion to investigate day and night.

The children also need to know that in many experiments they will have to establish a control to give them a standard with which to compare their results.
The control is exactly the same as the experiment apart from the variable under investigation. Consider the following example to see how it works.

**INVESTIGATION 3: DOES A POND SNAIL GIVE OFF CARBON DIOXIDE?**

Suppose you want to find out whether a pond snail gives off carbon dioxide when it breathes. You will need to immerse the pond snail in something that shows when carbon dioxide is present. This is called an indicator. Hydrogen carbonate indicator is normally red but turns yellow when carbon dioxide is present.

Set up two test tubes as shown on the left-hand side of Figure 1. After 30 minutes you should be able to see that the colour of the indicator in test tube 1 has changed from red to yellow. However, nothing has happened to the colour of the indicator in test tube 2 (the control). This shows that the colour change is not caused by the test tube, the liquid or the air.

The control therefore proves that it must be the pond snail that causes the indicator to change colour in test tube 1. To do this the snail must be producing carbon dioxide. In this case the variable is the presence or absence of carbon dioxide.

**FIGURE 1** Arrangement of test tubes for snail experiment.

**INTERPRETING THE OBSERVATIONS**

The children will end up with a set, or sets, of observations, some of which may be the results of an experiment. They will need to work out what these observations mean, and at first will require a lot of assistance in doing so.

**DRAWING A CONCLUSION**

The children must now try to decide whether their interpretation supports their hypothesis. Has their original idea been shown to be true? If their observations do not support their hypothesis they may need to start again with either a new hypothesis or a different type of practical investigation.

Children can share their ideas by means of class discussions about their experiences and conclusions. These discussions encourage children to develop their ideas and become aware of a wider range of experiences, thus enabling them to make generalizations from specific findings.

At every stage therefore they will need opportunities for discussion—with each other in small groups, with you, or by giving presentations to the class and
asking for comments. In order to be well prepared, you must have already given
detailed consideration to such questions as the following. What do you want the
children to look for? Should they approach their observations and activities in a
particular sequence? Should they be measuring anything—if so, what is the most
appropriate means of doing this? (More about this in Section 3.) What type of
recording should be done? etc.

Of course, even with well-planned investigations things can turn out
unexpectedly, but planning each stage carefully beforehand gives you the best
chance of isolating any problems that do arise.

Successful engagement with AT1 will provide the means by which the children
can acquire knowledge and understanding of other attainment targets. In this
sense you can foster the interaction of profile components 1 and 2 rather than
addressing them as separate entities—which is a potential danger inherent in the
way the national curriculum document is structured. It is worth mentioning here
that the term ‘investigative approach’, taken in a wider sense, can be used to
describe the attitude you promote through activities such as classifying, and
sorting cut-out pictures, objects, articles, etc.—a questioning active approach.

So, by encouraging the children to work systematically in science you will
provide opportunities that ensure they acquire and learn how to use the skills
specified in AT1—particularly levels 1 to 3, first within a given task and then in
a more general way, i.e. when presented with a new problem.

Faced with a new problem, they must be able to identify what activities are
necessary, and in what sequence they should be performed, in order to reach a
solution. Being able to use each particular skill in isolation is not enough; they
must also learn how to incorporate relevant skills into an overall design.

The following question is useful to illustrate this.

• Which type of paper is more effective for drying a wet table: kitchen paper
  or paper hand towels?

You might like to spend some time in your tutorial group discussing the ways
in which you would expect the children to respond to this problem.

Clearly, the problem could be solved by mopping up one area of the table with
one type of towel and using the other to mop a different part of the table; you
could then make a qualitative judgement about which towel has the best drying
capability.

However, if you considered the response to the problem in more detail you
would find that it involved some or all of the following skills (these skills are
all within the scope of AT1—the relevant level is given in parentheses after each
skill):

• observation (1)
• communication of ideas (1)
• questioning (2)
• prediction (2)
• identifying differences (2)
• listing and collating observations (2)
• interpreting findings by associating one factor with another (2)
• recording findings (2)
• formulating hypotheses (3)
• distinguishing between fair and unfair tests (3)
• selecting and using instruments to enhance observations (3)
• constructing a fair test (4)
• drawing conclusions from experiment results (4).

You can probably go on to list others. The point is, would the children, given their abilities, know what procedure to follow, which skills to select and how to execute those skills?

The potential danger of not fully integrating profile components 1 and 2 is great, even (or perhaps especially) when they can use the skills in isolation or in a specified context, because then they and you may be in danger of complacency.

You will need to design and select activities that provide opportunities for children to show what level of attainment they have reached. If you intend to work from published resource cards you will need to check very carefully that they have an emphasis that allows children to achieve the attainment levels.

KEY POINTS

• Your role is crucial in selecting and presenting appropriate practical activities that will help the children to achieve attainment levels in AT1, which provides the basis for achieving subsequent attainment targets.

• In order to present a systematic programme of activities, you need a clear understanding of investigative/practical work yourself.

3 HANDLING EXPERIMENTAL DATA

Main attainment target and levels addressed in Section 3: AT1: levels 3 to 5

STUDY NOTES

Section 3.1: It is essential that you study this Section carefully, because in this Course you will often be asked to draw and interpret graphs, in order to display and understand experimental data. It is particularly important that you do SAQs 1 and 2, as they will help you to revise the art of graph plotting. When you have completed SAQ 2, read the answer carefully.

Section 3.2: In any scientific measurement there will always be some degree of uncertainty. Therefore, when a scientist wants to assign a particular quantity he or she will not usually make a single measurement, but instead will try to find the best value of the quantity together with its associated uncertainty. Section 3.2 introduces this crucial concept.

Section 3.3: The two types of uncertainty, random and systematic, are discussed. You should be aware of the distinction between these two types, but don’t spend too much time on this.

Section 3.4: This Section should allay any fears you have about the difficulty of making numerical estimates of uncertainties. In this Course, all you are asked to do in order to estimate an uncertainty is to use the simple procedure discussed at the bottom of p. 19.

Section 3.5: It would be hard to overestimate the importance of significant figures in experimental science, so you should read this Section very carefully. The crucial idea that you should try to grasp is that a result can be quoted sensibly only to the number of significant figures consistent with the known uncertainties in the measurements. For example, if a student were to measure the length of her index finger with an ordinary ruler it would be inappropriate to quote the result as, say, 8.14567 ± 0.56332 cm, because an ordinary ruler simply does not allow measurements to be made with such high precision. In
this case, it would be much better to quote the result as $8.1 \pm 0.6$ cm, because an ordinary ruler does allow lengths to be measured to two significant figures.

It is also very important that you bear in mind the need to quote a sensible number of significant figures when using a calculator. Suppose, for example, that you are asked to find the average speed of an object that travels a distance of 2.0 m in 3.0 s. If you apply the formula

$$\text{average speed} = \frac{\text{distance travelled}}{\text{time}}$$

your calculator will tell you that the object’s average speed is

$$\frac{2.0 \text{ m}}{3.0 \text{ s}} = 0.666666 \ldots \text{ m s}^{-1},$$

You should not fall into the trap of quoting the average speed to the number of figures displayed on your calculator: this cannot be justified, because you can only quote the result to the same number of significant figures as the least precisely known data point. In this case, distance and time are both known to two significant figures, so we should quote the average speed as $0.67 \text{ m s}^{-1}$, i.e. to two significant figures.

Boxes 5 and 6 contain much wisdom that is well worth heeding.

TEACHING NOTES

From as early as AT1, level 3, children are expected to construct and interpret simple graphs, and by level 4 they will be expected to use line graphs and bar charts as means of recording or representing data.

Representing results in the form of graphs will also greatly assist them in their interpretation of observations in terms of generalized statements—in fact, the example in Figures 7 and 8 in Section 3.1 of Unit 4 (pp. 9 and 10) is exactly that given in AT1, level 3 of the national curriculum!

Section 3.1 gives you ideas for structuring some sessions with the children that centre on the theme of ‘Why use graphs?’ The outcome of these sessions should be to decide on a few ‘rules’ for drawing accurate line graphs.

By level 5 children will be expected to identify and manipulate relevant independent and dependent variables. These are covered in Section 3.1.

You also need to develop the theme of ‘How reliable are your results?’, which is discussed in Section 3.2 by pointing out that sometimes our measurements need to be very accurate (e.g. when constructing a Moon rocket) whereas at other times they do not (e.g. when baking a cake). You can show the uncertainties associated with measurement by weighing things using a variety of instruments, e.g. a tablespoon, balance scales, calibrated scales, electronic scales, or by measuring lengths using hand spans, a wooden ruler, a tape measure, a micrometer, etc. Make it clear that when following a recipe, you can measure out the ingredients using a tablespoon, balance scales or calibrated scales. While the level of associated uncertainties of the measurements will be highest if a tablespoon is used, lower if balance scales are used and lower still if calibrated scales are used, when baking a cake the degree of precision obtained from using a tablespoon is usually perfectly adequate.

KEY POINTS

- Graphs are a key method of recording.
- There are associated uncertainties with values obtained in experimental work in science.
4 THE STATISTICAL APPROACH: STANDARD DEVIATION

Main attainment targets and levels addressed in Section 4: **AT1: levels 1 to 5**

**STUDY NOTES**

This short Section introduces the important concept of standard deviation. At this stage you do not need to use the rather complicated formula for working out standard deviation, so you may find it easier to read the following paragraph than to read the text of the Section, which may appear rather intimidating.

Suppose you were asked for information about the heights of the children in your class. Obviously, it is not very useful to quote only the average height because the children do not each have the same height—there is a spread of heights, from the shortest to the tallest, with the average in between. The standard deviation of all the values is simply a measure of the spread of heights around the average (see Figure 26 of Unit 4, p. 27). Note that the spread is not the difference between the tallest and shortest heights—it is the spread that encloses 67% of the sample.

So, for example, if you quoted the height of the children in your class as the average ± a standard deviation, that is, if your results were (1.0 ± 0.2)m, then the average height of all the children in your class is 1.0 m, and 67% (about two-thirds) of the children have a height that is between 1.2 (1.0 + 0.2)m and 0.8 (1.0 - 0.2) m. The remaining 33% have a height that is outside this range.

Note that the bigger the standard deviation of a sample, the wider is the spread about the average value.

**TEACHING NOTES**

Although statistical analysis of data is not mentioned until level 9 in AT1, the idea that there can be a spread of values about the average, and that the extent of the spread of values can vary, is of great value in 'representing' children's studies of variation. This is central to AT2, levels 1, 3 and 4. Children in reception classes can gain from recognizing and measuring similarities and differences amongst themselves and other living things. You can work with the children devising a number of ways of representing that variation quantitatively.

Spend some time now compiling a short list of innovative ways in which the children could investigate and represent variations between themselves. We give a couple of ideas to start you off.

- Measure head circumferences or hand spans with strips of coloured paper and paste them on to two axes to make a bar chart of the results.
- Record heights of children in the class, depict the results as a histogram and put the results into a table. For 7-year-olds or older children this could be a frequency table, as shown in Table 2 (opposite).

You might also want to discuss with your class the concept of continuous and discontinuous variation. (This will be discussed further in Unit 20.) Of course, you need not use the specific terminology, but children are likely to be interested in knowing that things vary in two different ways. They may vary:

- in a continuous range, so that every value between two end points is possible, e.g. hair colour (you might consider making a colour chart to represent the subtle differences in shade between children in the class), height, mass; or
discretely, so that people fall into distinct groups, e.g. gender, blood group, the ability to roll the tongue (i.e. curl up both sides of the tongue).

### TABLE 2 Frequency table showing heights of children in class

<table>
<thead>
<tr>
<th>Heights (in metres)</th>
<th>No. of children in class of this height</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 0.70</td>
<td>3</td>
</tr>
<tr>
<td>0.70–0.79</td>
<td>2</td>
</tr>
<tr>
<td>0.80–0.89</td>
<td>2</td>
</tr>
<tr>
<td>0.90–0.99</td>
<td>3</td>
</tr>
<tr>
<td>1.00–1.09</td>
<td>3</td>
</tr>
<tr>
<td>1.10–1.19</td>
<td>2</td>
</tr>
<tr>
<td>1.20–1.29</td>
<td>2</td>
</tr>
<tr>
<td>&gt; 1.30</td>
<td>2</td>
</tr>
</tbody>
</table>

### KEY POINTS

- The standard deviation of a set of values is a measure of their spread around the average.
- You should aim to work with your children devising a number of ways of representing variation (i.e. the extent of the spread of values for any character) quantitatively.

### 5 WRITING REPORTS OF PRACTICAL WORK (AV SEQUENCE)

**Main attainment target and levels addressed in Section 5:** **AT1: levels 2 to 5**

### STUDY NOTES

It is essential that you work through this sequence in order that you can write up the Moon experiment properly. Note that the good practice described here applies to all scientific report writing.

### TEACHING NOTES

This very important Section will help you to order your own thoughts on and understanding of the Moon experiment as a prerequisite to writing a scientific report. You will find that this activity has great personal value as you begin to acquire scientific expertise and will help to develop the science presented in Unit 2. It also has an immediate relevance to the science you are engaging in with the children.

While it is true to say that you will not be asking them to produce formal scientific reports at primary level, the logical sequencing of their thoughts, actions and recording of their findings in some appropriate way should be encouraged from the outset. Learning to sequence ideas and actions is vital to the development of the skills of describing, communicating and recording findings—required from levels 1 and 2 onwards. The ability to sequence ideas and actions enables children to plan things, first in outline and then in more detail.
Developing ways for children with limited language and written skills to make recordings of their findings in science is a particularly challenging problem. The following ideas will give you a flavour of the variety of techniques you can use; you should be able to think of others for yourself:

- expressive language and writing, whereby the children make sense of the new ideas and information gained through engaging in science at school by relating them to their everyday experiences
- sequences of drawings to show what happened in an investigation
- sketches of materials used in an investigation, or of what happened in the investigation, with various parts magnified
- collection of cut-out pictures, stuck on to a large sheet of paper and then mounted on the wall
- pie charts
- flow charts
- simple tables
- models
- photographs of completed work/projects.

To help children think imaginatively and learn to solve problems, you must encourage them to look at their ideas and findings in as many different ways as possible. If you impose too rigid a structure, or suggest too limited a range of ways of recording science or of relating topics to other areas of the curriculum, you might inadvertently exclude their own ideas. However, it is important that you always bear in mind the science content of your activities in order to provide ideas and help to develop the children’s understanding of concepts.

KEY POINTS

- You should spend time developing your own skill of scientific report writing.
- You will face the challenge of developing innovative ways for children to record the investigative work they do in school.

DISCUSSION TOPICS

- Prediction in primary science.
- The concept of a fair test.
- Questioning.
- Communication of ideas in science.
- Ways of recording in science.

RESOURCES

There is no Resources list associated with this Unit.

QUESTIONS

There are no questions in this Study Commentary.