Task A1

You need Resource 1

Read the account in Resource 1 of how an investigation about heartbeat rates was planned and undertaken by pupils in the fifth year of primary school. Then, working as a group:

i List all the kinds of information relevant to the children's scientific development that the teacher gained in the events described. (It may help to focus on one child, the one called J.)
ii Indicate how you think these kinds of information were gathered by the teacher.
iii What aspects of development were assessed in these activities?
iv What else would the teacher need to do to assess the children's achievements?

In each case note points about which there is disagreement as well as agreement within the groups. Prepare to report on your answers and discussion to other groups.

Task A2

You need Resource 2

Resource 2 is an account of an activity deliberately devised to provide opportunities for assessing pupils' work in science. Put yourself in the position of the teacher and, with your group, answer these questions:

i What kinds of information would the teacher be able to collect about the pupils?
ii What basis for assessing their performance would be the most appropriate? Consider each of these:
Pupil-referenced – comparing the information with what that particular pupil could do at an earlier time
Criterion-referenced – comparing the information with a specified standard of performance
Norm-referenced – comparing with what is the norm (or average) for pupils of the same age or stage.

Task A3

You need Resource 3

Read the three tasks, A, B, and C in Resource 3 which assess in different ways children's ability to investigate. Then answer these questions and give a reason for your answer in each case. Do this individually and then share your views with the group.

i Which task (A, B or C) do you think is the closest to assessing how well the children can investigate something?

ii Which one gives a result that would be most likely to be judged in the same way by different teachers?

iii Which is the most interesting from the point of view of the children?

iv Which is the most convenient for the teacher?

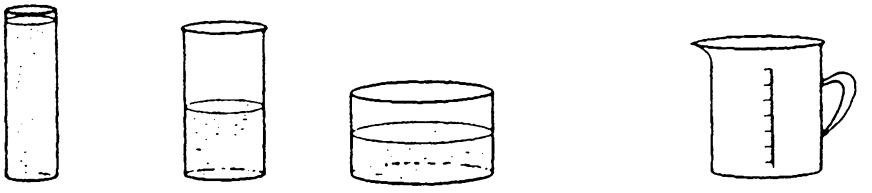
v Which task would be best for finding out what the children would do to investigate, even if the teacher can't let them do it?

Don't forget to give the reason for your choice!

Task B1

First read this episode

An 8-year-old child was given three containers, A, B, and C, as shown and a measuring jug. The child was asked to label them 1, 2 and 3 according to the amount of water in them, giving 1 to the one containing the most and 3 to that containing the least.



A B C Measuring jug

The child's answer was: A = 1, B = 2, C = 3.
The teacher marked A = 1 as correct but the other answers as wrong.

The teacher was puzzled that only the first answer was correct.

She asked the child: "Why do you think all your answers are correct?"
The child replied: "Because I did the same for all of them, I looked at the height of the water level in each one and numbered them."

i Suppose the teacher had not questioned the child to find out why only one answer was correct, what could have been the consequences for the child's immediate learning?

ii If you were the teacher in this situation how would you react to the child? Work with a partner and take turns to role-play the child and the teacher. Write down what you think is the best way of reacting to the child.

Task B2

You need Resource 4 (later Resource 5 will be distributed)

i For each episode in Resource 4, write down what the teacher would be able to assess using the information (s)he could collect in these situations. Brainstorm the ideas in your group onto a chart like this:

Situation	Information obtainable
A	
B	
C	
D	

ii Now consider the examples of criteria for assessing skills, attitudes and concepts of primary children in Resource 5. List the criteria that might be used for assessing in these situations. Complete a chart of this kind:

	Process skills	Ideas	Attitudes
A			
B			
C			
D			

Task B3

First read this episode

One week before a test, 7-year-old children are asked to observe a living spider closely and told that the test will be such that they can answer it well if they have observed the spider well. The children will answer orally or on paper (as a picture or using words).

Working as a group:

i Write five questions to assess how well the children have observed the spider.

ii Imagine you are the teacher. How will you arrange for the assessment to take place? How will you plan the session when the children are giving their answers so that each one can be assessed?

iii Suppose the teacher wants to assess children whilst they are investigating some materials. How could (s)he do this with at least eight groups of children?

Task B4

i In the episode in B3, in what ways might the children take part in assessing their own work and/or each other's work? How might your answer differ if the children were 10 years old instead of 7?

ii How would practice have to be modified in very large classes?

iii What advantages and disadvantages do you see in children taking part in assessment?

iv What examples of children taking a role in their assessment can you give?

Task C1

You need Resources 5 and 6

Working as a group, answer questions (i), (ii) and (iii) and be prepared to share your answers with other groups.

i Read the account in Resource 6. Imagine you are the teacher. By observing the children, what would you be able to find out in relation to the sections in Resource 5 on *observing* and *investigating*

ii To what extent do you think the lists of criteria would help you, as the teacher, in assessing the children's process skills by observation?

iii What are the advantages and disadvantages of assessing children by observing them?

Task C2

You will need a sealed matchbox and Resource 7

i Divide into pairs. Each pair has a sealed matchbox. Neither of you knows what is inside the matchbox. Handle it and form your own ideas of what is inside *without saying anything*. The idea is to find out by questioning what the other person *thinks* is inside. Each person should devise three questions and then take turns to ask each other their questions. Then decide which question(s) were most productive in finding out the other's idea.

ii Work as a group with Resource 7. Read the examples of questions asked of pupils by teachers. Divide them into groups of different *kinds* of questions (ignoring the subject matter). Do this in any way you think makes distinctions between questions that are helpful for the purposes of ongoing assessment and those not so helpful. Be prepared to say what it is that makes some questions more useful for this purpose. Record your result using the numbers of the questions and write these on a large piece of paper.

Task C3

You need a clockwork toy or home-made cotton reel 'tank'. (Later Resource 8 will be distributed)

i Wind up the toy or 'tank', set it moving and watch it for a short while. Then, working alone, make a drawing to show what is happening to make it move in the way it does. Don't label the drawing. Now exchange your drawing with that of your partner. Ask your partner questions to help you understand his/her drawing of how the toy is moving. Then let your partner question you about your drawing. Then add labels and annotation to your drawings that answer the questions you have been asked.

ii As a pair, exchange your annotated drawings with another pair and see how well you can understand their drawings from the start after they have been annotated. Look at the examples of children's drawings in Resource 8. What can you tell about the children's ideas from these drawings? Discuss how you would set up the tasks for these children so that they annotated their drawings to show their ideas.

Task C4

i Working alone, for no more than 5 minutes, write down your ideas about the answer to this question:
Why do you think our hearts beat more quickly during and just after exercise?

ii Exchange your writing with that of your partner. Consider whether this helps your own understanding and answers any of your questions.

iii Discuss as a group the implications of this for asking children to write in science and the use made of their writing in class activities.

vi Reflect on the experience of working in a group in the tasks in this module:
- How well did the group work together?
- What were the reasons for this (working well or not)?
- How did you feel when working alone at the beginning of this task compared with sharing ideas?
- What was achieved by working with others that could not have been achieved by working alone?

v Discuss the implications of the group interactions for the performance and learning of individuals. Is there a case for assessing a group of children as a whole in a particular activity?

Task D1

You need Resource 9

The lesson on fabrics in Resource 9 is described as having three phases:
exploratory phase
investigation phase
reporting and reflecting

i Identify the information relating to assessing skills, attitudes and understanding that the teacher could gather about the pupils in each of these phases.
ii Identify where the teacher used information from assessment immediately in the progress of the activity and in his planning.
iii What other information might the teacher have gathered and used during this lesson?

Task D2

You need Resources 1 and 5

i Read Resource 1 (or look at it again if you have already done so) and decide what you can tell about child C's achievement in the skills and attitudes in Resource 5.

If you don't think there is any evidence, leave a blank. Complete the first column of a table such as that below.

ii Suggest what the teacher should do to help C development of the skills and attitudes for which there is information about achievement. Give as much detail as you can.

	Achievement shown	Action by the teacher
Observing		
Explaining (hypothesising)		
Predicting		
Raising questions		
Planning and conducting investigations		
Interpreting (drawing conclusions)		
Communicating		
Respect for evidence		
Flexibility		
Critical reflection		

Task D3

You need Resource 10

Look at the examples of children's writing and drawings in Resource 10.

For each one consider:
- the evidence in relation to whether the child has understood the idea that is stated as the aim
- what action the teacher should take to help further development.

Complete the following table:

Example	Evidence related to aim	Action by the teacher
A		
B		
C		

Task E1

You need Resources 5 and 11

Look at the methods of recording of Teachers 1, 2, 3, and 4, in Resource 11.

Working in groups of four:

i Three of the main purposes of record keeping are:
a keeping track of the achievements of the children
b helping the teacher's planning to match the children's achievements.
c keeping track of the activities completed by the children.
Consider the advantages and disadvantages of the methods used by Teachers 1, 2, 3, and 4 for each of these purposes.

ii What advantages and disadvantages are there of involving children in keeping records? What part could the children have in keeping these records?

iii How might these records be modified to make recording practicable with very large classes?

iv Would these kinds of records be useful for other subjects in the primary school? What would be the advantages and disadvantages of incorporating science with other subjects in a single record?

v What other forms of record are used by members of the group? What are their advantages and disadvantages for purposes **a**, **b** and **c**?

Task E2

You need Resources 5 and 11

Consider again the records in Resource 11 but this time to decide how the information for each child could be summarised to provide an assessment of achievement at the end of term or of the school year. This is the summative assessment that would be the basis of an end-of-year report to parents and would be passed to the child's next teacher.

i For each of the records answer these questions:
a How might the teacher go about producing a summative assessment from the ongoing record?
b What form could the summative assessment take?
c How reliable do you think the assessment would be?

	How to produce the summative assessment	Form of the summative assessment	How reliable?
Teacher 1			
Teacher 2			
Teacher 3			
Teacher 4			

ii Consider how the process of producing end of term/year reports could be streamlined to help teachers of very large classes.

Task E3

The Head Teachers of the schools where Teachers 5, 6 and 7 teach were not confident that a fair summative assessment could be derived from the records of ongoing assessment. They therefore obtained a collection of test items and practical tasks which could be used at the end of each year to provide the summative assessment. The test items and tasks had been tried out and analysed so that they could be labelled according to the skills and understanding of ideas they assessed.

In the school of Teacher 5, selections of the items and tasks were put together to make tests suitable for each age level. The tests were rather similar to the children's normal work and so there was no feeling of being tested. The children took the tests at the end of the year, the teachers marked them, using the mark schemes provided and the total score for each child obtained in this way formed the summative assessment.

In the school of Teacher 6, the Head Teacher told the teachers to use their judgement and their ongoing records to decide whether certain criteria had been met. They were then to select appropriate tasks and test items and use these as part of the children's activities, to check their own judgements. Where there was disagreement, teachers looked again at the evidence from both sources and refined their view of how to judge certain kinds of achievement.

In the school of Teacher 7, there was a combination of externally produced tests, marked by the teacher, and assessments based on the teacher's ongoing records. The tests were given 30% of the marks and the teacher's assessment 70% per cent.

In pairs:

i List the strengths and weaknesses of the approaches used in the schools of Teachers 5, 6 and 7.

ii Identify the conditions in which you would use each of these approaches. Give your reasons.

Join with another pair and identify any points of disagreement. Be prepared to report these.

Task F1

You need Resource 12

Read the three test items in Resource 12 and answer them. Then decide, as a group:

i What skill, idea, or factual knowledge is being assessed by each item?

ii For what age levels are these items suitable? What are the reasons for your suggestions?

Task F2

You need Resource 13

For each test item in Resource 14, decide what idea(s) and process skills(s) are being assessed and for what age level it is appropriate? Work in pairs and complete a table of the following kind:

Item	Idea(s) assessed	Process skill(s) assessed	Appropriate age
1			
2			
3			
4			
5			
6			
7			
8			

Task F3

You need Resource 14

Work as a group. Read the answers (Resource 14) given by some 10-year-old children to item 2 in Resource 13.

i Can you mark each of these answers as 'correct' or 'incorrect'?
If not, which do you think deserves most marks? Which deserves least marks? Why?

ii Devise a mark scheme for this question.

Task F4

You need Resource 15

Devise a test item and mark scheme to assess each of the following specifications:

i An item using the context of the conditions needed by plants for life and growth and testing the process of controlling variables, suitable for 8/9 year-olds.

ii An item applying simple ideas about forces suitable for 7/8 year-olds.

iii An item using the context of shadows and testing the process skill of predicting, suitable for 9/10 year-olds.

Task F5

You need your local curriculum planning document for science

Select a part of the current science curriculum for pupils in the fifth or sixth year of primary school and prepare items to assess understanding of the relevant ideas and the skills that are intended to be developed. Prepare mark schemes for these items in a suitable form.

Resource 1

As part of the topic "Ourselves" a class was studying the circulation of the blood. The teacher asked:

"What do you think your blood does?"
"How do you think it moves around your body?"

In the discussion of ideas that followed the children began to press their hands on their chests and to feel their hearts beating.

The teacher asked if they knew of any other way of finding out about their heartbeat. J suggested feeling the pulse at the wrist and the teacher showed them how to feel the pulse in the neck. They began to count the beats, but before they timed them, the teacher asked them:

"How many times do you think your heart will beat in a minute?"

Their predictions ranged from 50 to 80 beats a minute. J suggested 60 per minute. Then they began to count the beats, timing with a watch that had a minute hand. They put their results into a table (see J's results).

From the table they noticed that S had the slowest heartbeat. S was the smallest in the group. They thought that the heart beat was related to size, increasing with a person's size. They decided to take the teacher's heartbeat to see if this was right. Their prediction was that the teacher's heartbeat would be higher than any of the children's. C wrote his prediction and the reason for it:

"I think Sir's heart beats 89 times because the blood takes longer to travel round the body."

The children discussed whether an adult's heartbeat would be different for other reasons, such as age.

The teacher asked them if they could find out if size affects the heartbeat. The children decided that they needed to measure height and weight. They chose to measure height with a metre measuring stick and to use bathroom scales (marked in stones). For each measurement the teacher asked the children to make a prediction before using the stick or scales. See J's report of his investigation, results and conclusion.

After the investigation the teacher explored the children's ideas about the circulation of the blood and their ability to investigate by asking them to write the answers to these open questions:

1. During and after exercise your heartbeat goes up more quickly than when you are not moving. Why do you think this is? Write down as many reasons as you can.

2. How much does your heartbeat change when you have been running hard compared with sitting still? How would you find out? Make a list of all the things you would do, in the order you would do them, to answer this question.

J's report of his investigation of heartbeat rates

We are going find out if older peoples heart beats are faster or slower

I think Sirs heart will beat 78 times a minute

We found that Sirs heart beats 71 times a minute

We are going to weigh and measure each other and see if height make a difference

J	63 beats
S	50 beats
M	65 beats
C	65 beats
Sir	71 beats

Name	Estimate	Answer
J	154	147
S	120	129
M	140	134
C	150	147
Sir	195	171

Name	Estimate	Answer
J	6stone	7stone
S	4stone	4stone
M	5stone	5½stone
Sir	9stone	11½stone
C	6½stone	7stone

I think that height and weight have nothing to do with it because C and M have the same heart beat but they're not the same height or weight.

Resource 2

As part of a study of camouflage in animals the teacher asked pupils to design and carry out an investigation of whether the pattern of the coat made animals less easy to see against a certain background.

The children worked in groups. They cut out the shapes of animals and painted them to represent a tiger, a leopard, a zebra and a lion. They used books to find out about the habitats of these animals and then painted different background pictures to represent them. They had to decide for themselves how to carry out the investigation.

When all the groups had finished, each group presented their findings to the others. The teacher encouraged them to question each group about the methods and materials they used and how they reached their conclusions.

The teacher assessed the children during their group work and the presentations, noting what questions they asked as well as how they answered each other's questions.

Resource 3

These are three tasks for assessing pupils' ability to investigate.

Task A

Suppose you want to find out which of two strips of wood will bend more easily. Which of these things would be best to do? Tick one.

1. Try bending them with your hands and feel which easier to bend. ☐
2. Find out what kinds of wood they are and then use a book to tell you the answer. ☐
3. Support the ends, put a load in the middle and see how much each one bends under the same load. ☐
4. See which one is easiest to hammer a nail into. ☐
5. Clamp each one to a table so that the same length overhangs. Then hang weights on the end to bend them. ☐

Task B

Describe what you would do to find out which of two pieces of wood was more bendy.

Say what equipment you would use (you can choose anything you like), what you would do and how you would find the result.

.....

.....

.....

.....

Task C

You have two pieces of wood and some equipment in front of you. Use these things to find out which of the pieces is the more bendy.

Resource 4

Episode A

As part of the study of creatures in their environment the teacher planned this activity in order to assess various aspects of the children's development in science.

Each child was given a creature to study and the task of finding out as much as possible about it over a certain period of time. The children could use books, observe the creature, ask adults, look at pictures, etc. The children also made a mask to represent their creature.

The whole class then came together and the children in turn put on their masks and told the other children all about 'themselves' as their creature. When each 'impersonator' had finished describing herself/himself, other children asked questions of the child about the creature being represented. The idea was not to guess what the creature was but to share information about it.

Meanwhile the teacher observed and assessed both the pupil answering and those asking questions.

Episode B

A teacher set up a display of materials and instruments that could be used to make pitched sounds. The 8-year-old children were given opportunities to observe and experiment with the materials and encouraged to find how to make sounds of different pitch from one object (such as a bottle with some water in it, or a rubber band stretched across a wooden box). The children were told to draw and write about what they found and the teacher assessed how they worked, as well as their written work.

Episode C

There are some sayings about the weather, that:

If the sky is red at sunset the weather next day will be dry.
If the sky is red at sunrise there will be rain later that day.

The problem given to a class of third-year children was to plan what they would do to test the truth of these sayings.

Episode D

Children in a fourth-year class in a rural school were asked to try out at home various ways of accelerating the decay of leaves to make compost. They were expected to keep records of what they did. At the end of the period of time allowed they were asked to present their findings to the class in any way they liked and they were assessed on the presentations.

Resource 5

Examples of criteria for assessing process skills

Observing

Do the children:

O1 succeed in identifying obvious differences and similarities between objects and materials?

O2 make use of several senses in exploring objects or materials?

O3 identify differences of detail between objects or materials?

O4 identify points of similarity between objects where differences are more obvious than similarities?

O5 use their senses appropriately and extend the range of sight using a hand lens or microscope as necessary?

O6 notice patterns, relationships of sequences that are to be found in a series of observations?

O7 distinguish from many observations those which are relevant to the problem in hand?

Explaining (hypothesising)

Do the children:

H1 attempt to give an explanation which is consistent with evidence, even if only in terms of the presence of certain features or circumstances?

H2 attempt to explain things in terms of a relevant idea from previous experience even if they go no further than naming it?

H3 suggest not only *what* but *how* something is brought about, even if the 'how' would be difficult to check?

H4 show awareness that there may be more than one explanation which fits the evidence?

H5 give explanations which suggest how an observed effect or situation is brought about and which could be checked?

H6 show awareness that all explanations are tentative and never proved beyond doubt?

Predicting

Do the children:

P1 attempt to make a prediction relating to a problem even if it is not derived from the evidence?

P2 make some use of evidence in making a prediction, rather than basing it on pre-conceived ideas?

P3 make reasonable predictions which fit the evidence without necessarily being able to make the justification explicit?

P4 explain how evidence has been used in making predictions?

P5 perceive and use patterns in information or observations to make justified interpolations or extrapolations?

P6 show caution in making assumptions about the generalisation of patterns beyond the evidence available?

Raising questions

Do the children:

Q1 readily ask a variety of questions which include investigable and non-investigable ones?

Q2 recognise the difference between an investigable question and one which cannot be answered by investigation?

Q3 realise when an investigable question is in a testable form?

Q4 generally, in science, ask questions which are potentially investigable?

Q5 quite often express their own questions in testable form?

Q6 ask questions which arise from making a prediction or giving an explanation that can be tested?

Investigating

Do the children:

I1 start with a useful general approach even if details are lacking or need further thought?

I2 have some ideas of the variable that has to be changed or what different things are to be compared?

I3 keep the same the things which should not change for a fair test?

I4 have some ideas beforehand of what to look for to obtain a result?

I5 choose a realistic way of measuring or comparing things to obtain the results?

I6 take steps to ensure that the results obtained are as accurate as they can reasonably be?

Interpreting (concluding)

Do the children:

Int 1 discuss what they find in relation to their initial questions?

Int 2 compare their findings with their earlier predictions?

Int 3 notice associations between changes in one variable and another?

Int 4 identify patterns or trends in their results?

Int 5 check any patterns or trends against all the evidence?

Int 6 draw conclusions which summarise and are consistent with the evidence?

Int 7 recognise that any conclusions may have to be changed in the light of new evidence?

Communicating

Do the children:

C1 talk freely about their activities and the ideas they have, with or without making a written record?

C2 listen to others' ideas and look at their results?

C3 report events in drawings, writing, models, paintings?

C4 use tables, graphs and charts to record and report results when these are suggested?

C5 regularly and spontaneously use information books to check or supplement their investigations?

C6 choose a form for recording or presenting results which is both considered and justified?

Willingness to collect and use evidence (respect for evidence)

Do the children:

RE1 report results which are supported by evidence even if the interpretation is influenced by preconceived ideas?

RE2 realise when the evidence doesn't fit a conclusion based on expectations, although they may challenge the evidence rather than the conclusion?

RE3 check parts of the evidence which don't fit an overall pattern or conclusions?

RE4 accept only interpretations or conclusions for which there is supporting evidence?

RE5 show a desire to collect further evidence to check conclusions before accepting them?

RE6 recognise that no conclusion is so firm that it can't be challenged by further evidence?

Willingness to change ideas in the light of evidence (flexibility)

Do the children:

FL1 readily change what they say they think, though this may be due to a desire to please rather than the force of argument or evidence?

FL2 change ideas when there is considerable evidence against the existing ones and little in their favour?

FL3 show willingness to consider alternative ideas which may fit the evidence, even if they prefer their own in the end?

FL4 relinquish or change ideas after considering evidence?

FL5 spontaneously seek other ideas which may fit the evidence rather than accepting the first which seems to fit?

FL6 recognise that ideas can be changed by thinking and reflecting about different ways of making sense of the same evidence?

Willingness to review procedures critically (critical reflection)

Do the children:

CR1 review what they have done after an investigation even though they may only justify rather than criticise it?

CR2 consider some alternative procedures which could have been used without necessarily realising their advantages and disadvantages?

CR3 discuss ways in which what they have done could have been improved even if only in detail?

CR4 consider, when encouraged, the pros and cons of alternative ways of approaching a problem to the one they have used?

CR5 initiate a review of a completed investigation to identify how procedures could have been improved?

CR6 spontaneously review and improve procedures at the planning stage and in the course of an investigation as well as after completion?

Resource 6

The teacher of a class of 8 –10 year old children began work on dissolving by asking who in the class put sugar in their tea. She took some water, put a small amount of white sugar into it and stirred. She did not use the word 'dissolve' herself but asked the children to say what had happened to the sugar. Some said it had 'disappeared', but on questioning they admitted that the sugar was still there. Others used the word 'dissolve' and she asked them to give examples of other things which they thought dissolved.

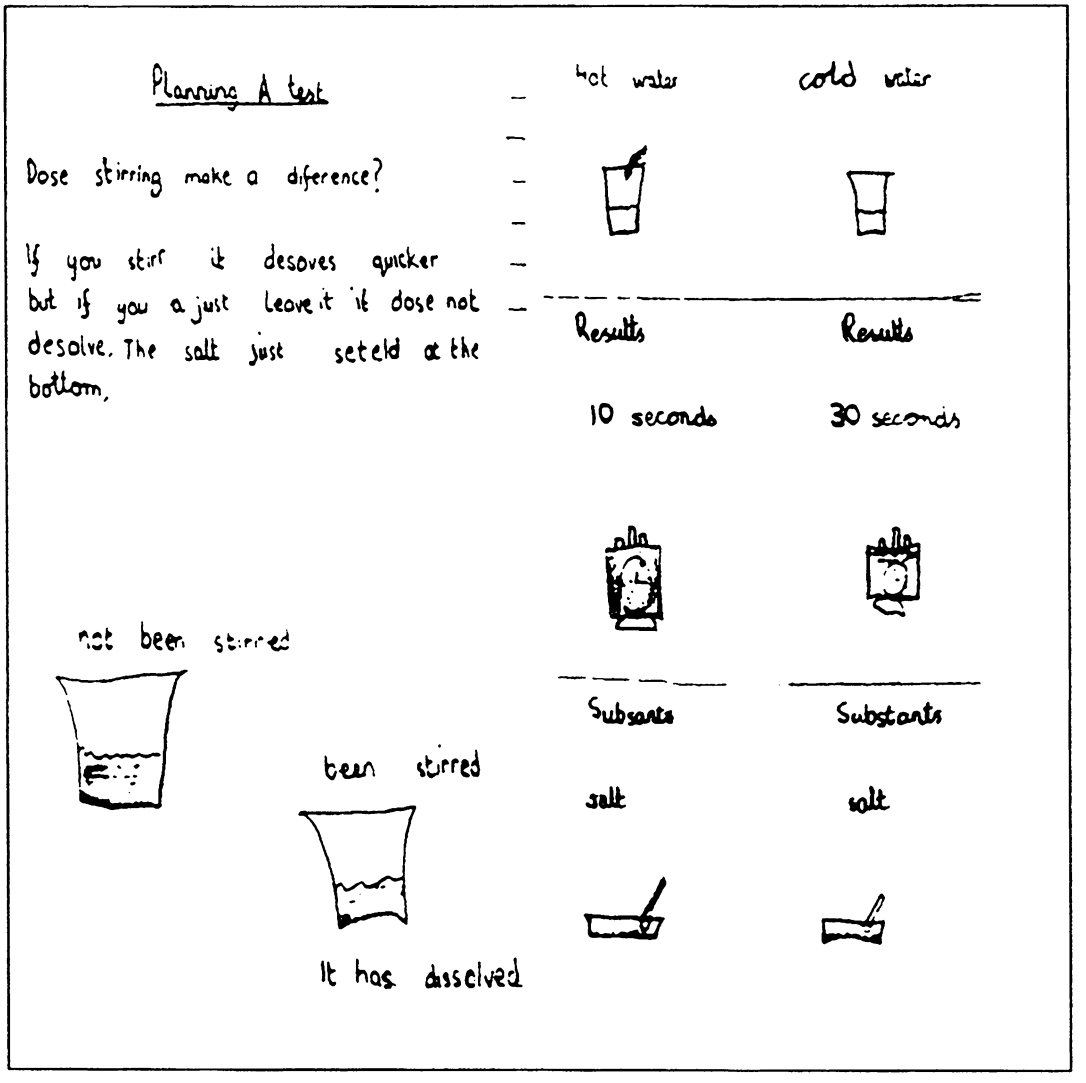
Then the teacher gave instructions for the children to begin group work. They were each given four substances (not the same for all groups) and were asked to find out if each dissolved, did not dissolve, or whether they could not tell. A's group produced this record:

Name of Substance	Dissolves	Does not dissolve	Not sure if it dissolves	Colours the water
brown sugar	yes			water change
OXO cube	almost			water change to light brown
salt	yes			
flour		yes		

The class was brought together to report their results. Differences between one group and another were explored. Some thought that they could tell if a substance partly dissolved and were challenged to say how they judged this.

Then the teacher asked them for ideas about how to make things dissolve more quickly. She accepted all their ideas and told them to try them out, using just one of their substances. The children were told to draw up a plan for their investigation, then do it and to keep records so that they could report to the whole class later. See the plan and record of A's group on the next page.

Plan and record of the investigation by A's group



Resource 7

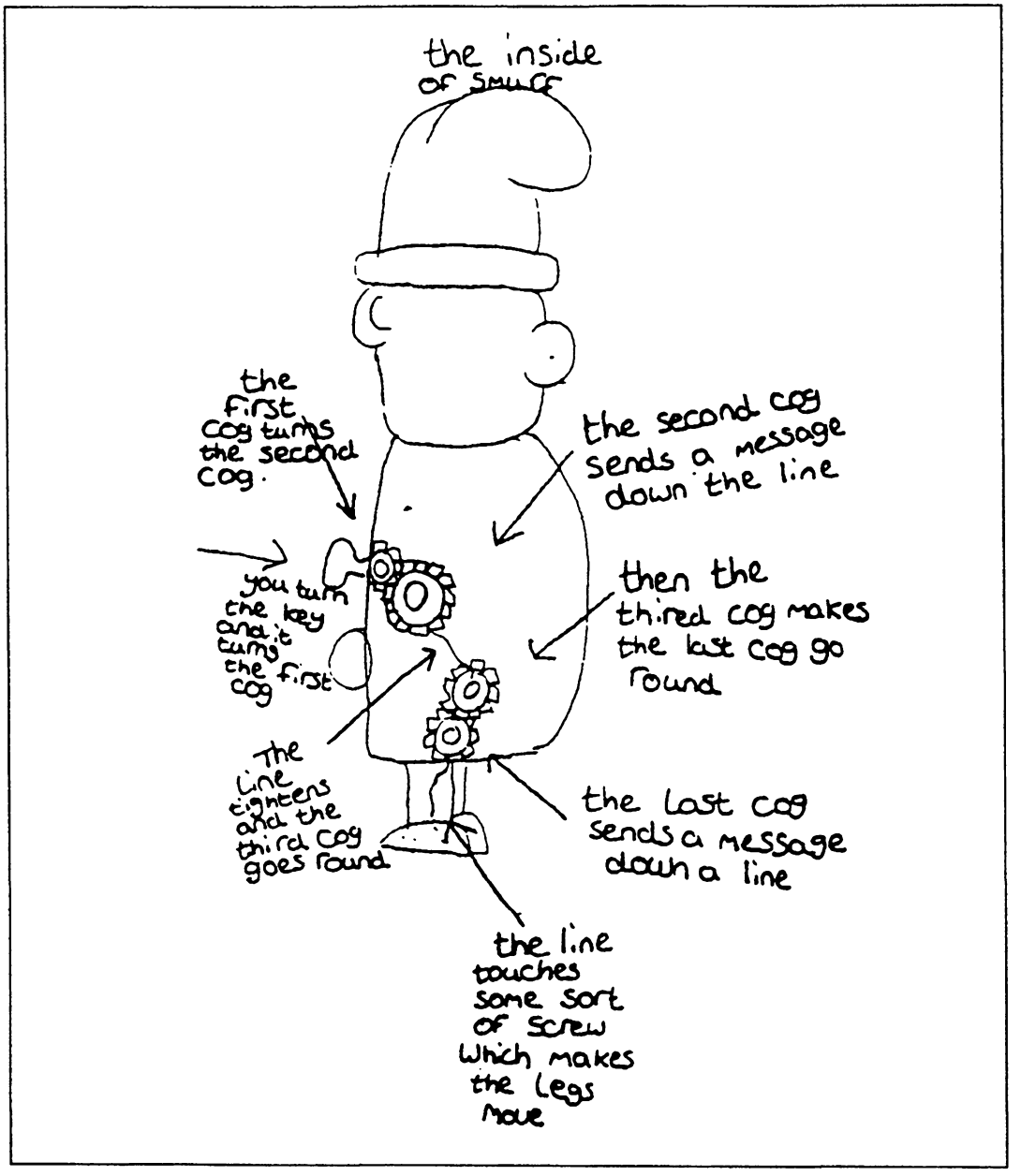
Some questions asked by teachers:

1. What are the differences between fruits and seeds?
2. Why do you think these (sycamore fruits) have these 'wings'?
3. What would you like to find out about these animals?
4. Why do heavy lorries take longer to stop than lighter lorries?
5. What happens when you put the stones in water?
6. What kind of metal are magnets made out of?
7. What do you think makes the flash of lightening appear before you hear the sound?
8. Why do you hear an echo under a bridge but not outside?
9. What do you think a seed needs to help it to grow?
10. How long does the Moon take to go round the Earth?
11. Do you think the rabbit likes the potato best or the carrot?
12. What makes the colour of the stones seem brighter when they are wet?
13. What is the part of a plant that is below ground?
14. How does soil help a plant to grow?
15. What do you think makes toffee sticky?

Resource 8

Children's drawings

Drawing 1

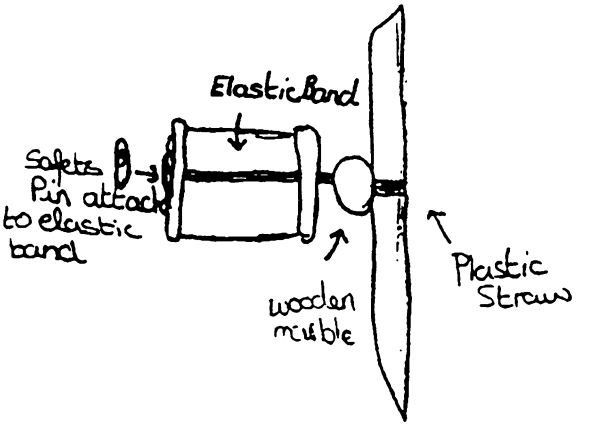


Drawing 2

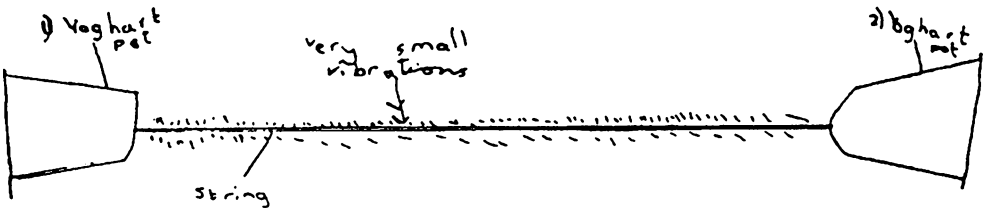
The cotton reel thing

It works by when you twist the plastic straw which is attached to the plastic elastic band, so when you twist the elastic band and put it on ground or water it moves I think it would work better in water because when you put on the ground its got the ground to hit it but when you put it in water it hasen't.

It stops because when you have twisted it the elastic band has just stopped twisting it has run out of that ergey



Drawing 3



The voice went to the string and were then transfered into vibrations which went down the string and when it got to the other yoghart pot (2) and were then transfered back to a voice.

Resource 9

The activities in this example took place with a class of third year primary children within an overall topic about clothing. The teacher planned that the children should discuss and investigate the selection of different fabrics for different purposes. He had in mind that the children should undertake some investigations of different fabrics, so he provided a collection of suitable pieces of fabric, etc, to which the children contributed. He wanted the investigations to advance the children's ideas and therefore to be based on their ideas and questions. It would have been easy to ask, for instance: *Which is the most waterproof material? Which is the most wind-proof?*, etc. and to start the children's investigations from these questions. These are perfectly good questions for children to investigate and likely to be among those the children ended up investigating, but he wanted to hold back his questions to find out what the children would ask and what ideas they had.

So the first part of the work was an *exploratory phase* of looking at the range of fabrics. In groups, the children were given samples of the fabrics, some hand-lenses and some very open instructions: to put the pieces of material into groups according to what they could be used for and then to explain what is the same about the items in each group and how the groups differ from each other. This task required children to use the ideas the teacher wanted to develop in making their observations; it encouraged them to look closely at the materials and to think about the differences they found. It was not a long activity but gave the teacher time to visit each group to listen in to what the children were saying about the materials. Many of their statements at this stage contained hypotheses and predictions. For example:

> *This would be all right for a coat to keep you warm – it feels warm. Look, these go together because they're thick and you wouldn't use them for clothes – something where it has to be very strong, like for covering a chair. You wouldn't use this for covering a chair, much too thin and easy to tear. This would be OK for a raincoat – it wouldn't let any water through.*

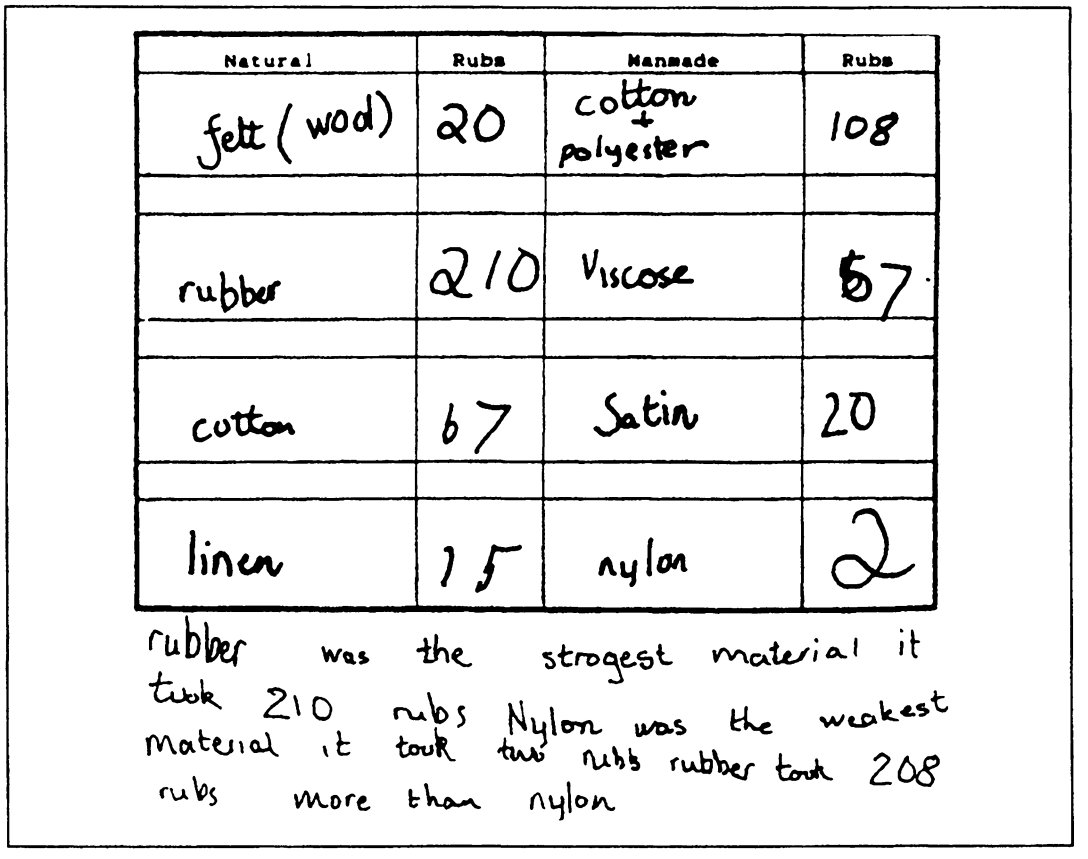
There was then a whole class discussion, pooling ideas from different groups. Two groups were interested in investigating one of the ideas emerging from the initial exploration, that natural materials are harder wearing than manufactured ones. Others followed up ideas about warmth and thickness and others did indeed investigate about what makes some materials more waterproof than others. Although the investigations were concerned with different properties, they were all relevant to developing the idea that the uses of materials are related to their properties.

In the *investigation phase* of the lesson the teacher used information about the children's ideas to set them going on investigations which used these ideas. The investigations provided opportunities to help the children develop their process skills, in order to carry out systematic and 'fair' tests which would arrive at findings useful in developing their ideas. So during the investigation the teacher needed to gather information about the children's process skills and to use this to give them any help they may have needed in thinking through how to collect evidence and make a record of it.

One group of girls took eight pieces of different kinds of material and compared them by rubbing them against the ground. The teacher observed that they chose the same piece of ground to test all the materials and they counted the number of rubs it took to make a hole. They kept to the same procedures and the same person rubbing. This method took a considerable time, however, and M suggested it would be quicker if they put a stone inside the material. So they wrapped each sample round a stone and started again. Their results were entered in a table drawn up for them by the teacher.

At the stage where results had been obtained, the teacher gathered information about how the children were interpreting what they had found out and whether their initial ideas had been changed. More information about this and about the children's communication skills was available in the *reporting phase* when the children made a report of the work, which they shared with the rest of the class. This also gave the teacher the opportunity to ask questions which challenged children to apply their ideas to closely related phenomena to find out the extent to which the children's ideas were becoming more widely applicable.

These were the results recorded by M's group.



Natural	Rubs	Manmade	Rubs
felt (wod)	20	cotton + polyester	108
rubber	210	Viscose	57
cotton	67	Satin	20
linen	15	nylon	2

rubber was the strogest material it took 210 rubs Nylon was the weakest material it took two rubs rubber took 208 rubs more than nylon

From their results, M's group first concluded that natural material is better than man-made but later, after discussing their results with their teacher, they wrote:

> *We don't know what's the best material because when we done our second test natural got the most points and man-made got the least point. But man-made material got the most points with our first test so we think man-made and natural have strong points.*

The written work alone gives no information about the extent to which they attempted to control variables or how they came to their first conclusion. The discussion with the teacher caused them to have second thoughts about this. Through the discussion the teacher was able to judge their use of evidence in arriving at conclusions and collected a good deal of information by observation which enabled him to see where these girls needed more experience.

Assessment in Primary School Science

This book is the product of a joint project undertaken by the Commonwealth Secretariat and UNESCO. It consists of nine modules designed to develop skills in assessment in primary science. The materials may be described as 'workshop' materials and are intended for use in courses for professional development led by a workshop leader. They are suitable for use with a wide range of participants: teachers, teacher educators, inspectors, curriculum developers, examination board staff and officials of the Ministries of Education. To allow maximum flexibility in the use of workshop materials a modular structure has been adopted. This will provide the workshop leaders free-standing modules from which courses tailored to specific needs can be created.

It was recognised that changes are needed, both in the formal tests and examinations, used to summarise achievement and sometimes to select and grade children, and in teacher's on-going assessment, to help in teaching and learning. Thus the materials reflect these purposes and are sensitive to many different contexts in which primary education takes place, including those where there are few material resources and large classes.

Commonwealth Secretariat

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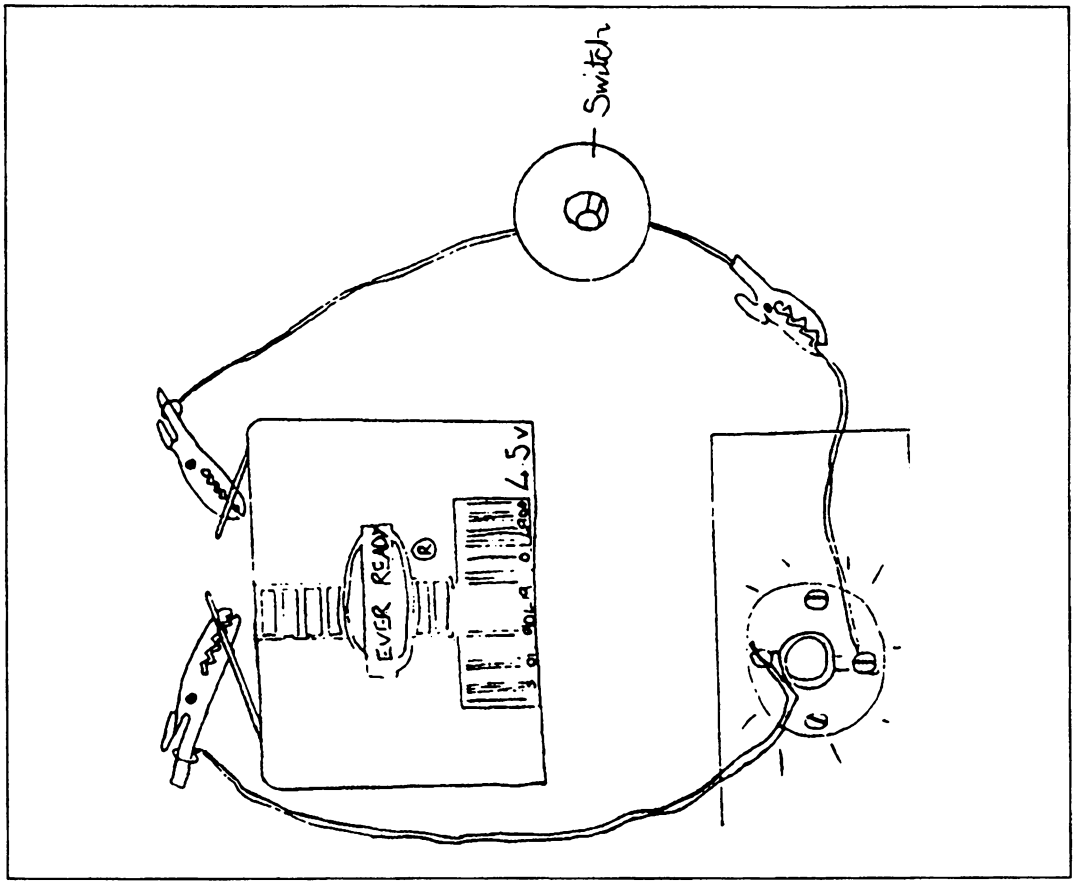
Example C

(Aim: Understanding of that the action of a switch is to close or break the path of conducting material in a simple circuit.)

Another pair produced this drawing of their circuit with a switch in it:



Resource 11

Four teachers each used a different way of recording their children's work:

Teacher 1

Teacher 1 kept weekly scores out of ten for each child. Marks were awarded either for tests administered by the teacher or for the children's work, in the following way:

Weeks	1	2	3	4	5	6	7	8	9	10	etc
Names	Marks out of 10										
Sam	6	5	8	6	7	3	4	9	7	8	
Sarah	7	8	6	7	5	6	–	9	6	7	
Brenda	3	4	5	3	6	7	5	–	6	4	
etc											

Teacher 2

Teacher 2 recorded comments on the children when they had completed particular activities. The record looked like this:

Activity Name	Dissolving	Separating soluble and insoluble	Evaporating a solution	Growing crystals	etc
Sam	*Messy unsystematic practical*	*Right idea but spoiled by carelessness*	*Made a good plan which worked*	*No success – he didn't follow instructions*	
Sarah	*Made a neat record; no conclusion*	*Tried without water before following what others did*	*Obtained a result but had difficulty explaining it*	*Watched others; had no idea why it grew*	
Brenda	*Careful practical work but poor record*	*Followed what the group did; no ideas of her own*	*Seemed to understand what to do but couldn't write it down*	*Absent*	
etc					

Teacher 3

Teacher 3 kept a record using a separate sheet for each child. Entries for the skills and attitudes referred to the developmental lists in Resource 5 and indicated the highest item observed in each case. Sam's record might have been like this:

Name: *Sam*
Record from _____ to _____

Activity	Dissolving and separating	Changing materials; heating and mixing	etc
Understanding ideas	Knew dissolved substance still there in the solution; applied idea in plan to separate sand and salt	Thinks that after a change the original can always be reclaimed somehow	
Observation	O4	O4	
Hypothesising	H2	H2	
Predicting	P3	P4	
Raising questions	Q4	Q4	
Planning and doing investigations	–	I3	
Drawing conclusions	Int 2	Int 2	
Communicating	C1	C2	
Respect for evidence	RE2	RE2	
Flexibility	F12	F13	
Critical reflection	–	Cr3	

NB No entry meant that there was no opportunity to observe this behaviour in these activities.

Teacher 4

Teacher 4 had a folder (portfolio) for each child in which the child's work was kept. This was mostly writing or drawing but sometimes actual samples of materials used or made (eg a crystal that had been grown):

Resource 12

Test item 1

Which of these things dissolves when you put it in water and stir?

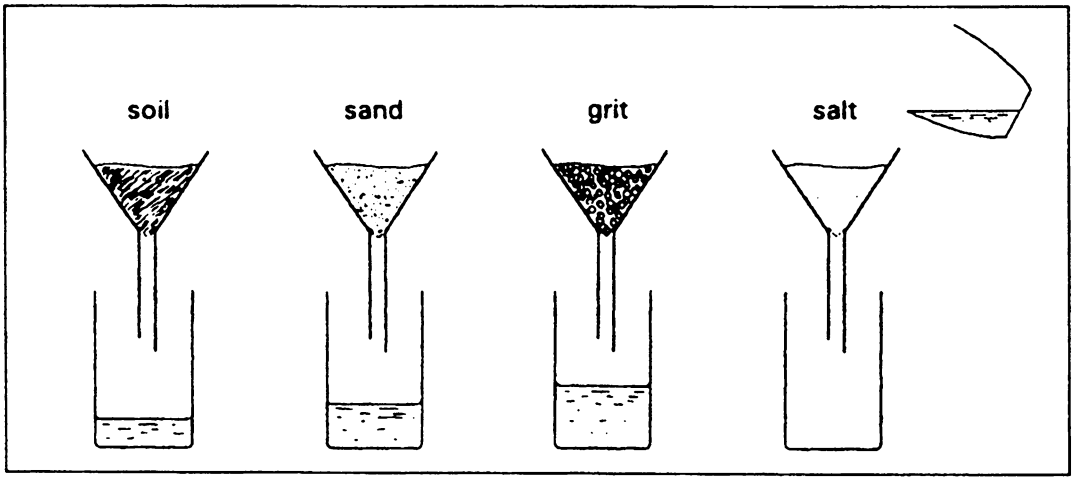
- Soil ☐
- Sand ☐
- Grit ☐
- Salt ☐

Test item 2

A group of children put equal amounts of dry sand, soil, grit and salt into four funnels.

To find out how much each one would soak up, they poured equal amounts of water into each one. They looked to see how much water dripped through.

This worked all right until they came to the salt. When they poured the water in the salt disappeared.



Why do you think the salt disappeared but the other solids did not?

.....

.....

.....

.....

Test item 3

A.
Rock salt

B.
Table salt

Imagine you have some rock salt (A) and some table salt (B).

You have to find out which dissolves most quickly in water, or whether they are the same.

- What would you do?
- How would you decide the answer from what happens?

Write or draw your answer here.

.....

.....

.....

.....

.....

Resource 13

Item 1

Look at the two seeds in front of you. Write down differences you can find between them and three ways in which they are the same.

Different	Same
1.	1. .....
2.	2. .....
3.	3. .....

Item 2

This is a model bridge made out of a piece of card and two blocks of wood. When the middle of the bridge is loaded with coins it collapses. The number of coins that it holds before collapsing for different spans was found to be:

Span in cm	Number of coins
10	5
18	1
12	4
16	2
14	3

What do you notice about the number of coins and the span of the bridge?

.....

.....

Item 3

When you take a cold can out of the fridge and put it in a warm room, the outside of the can become wet, even though it was dry when it was inside the 'fridge.

Why do you think the can becomes wet? .....

Where does the moisture come from? .....

Item 4

You are given three different types of cloth, scissors, water and a dropper. Write down what you would do to find out which of the materials would be best for mopping up spilled water.

.....

.....

.....

.....

Item 5

A girl measured how far a clockwork toy would go for different numbers of turns of the key. This is what she found:

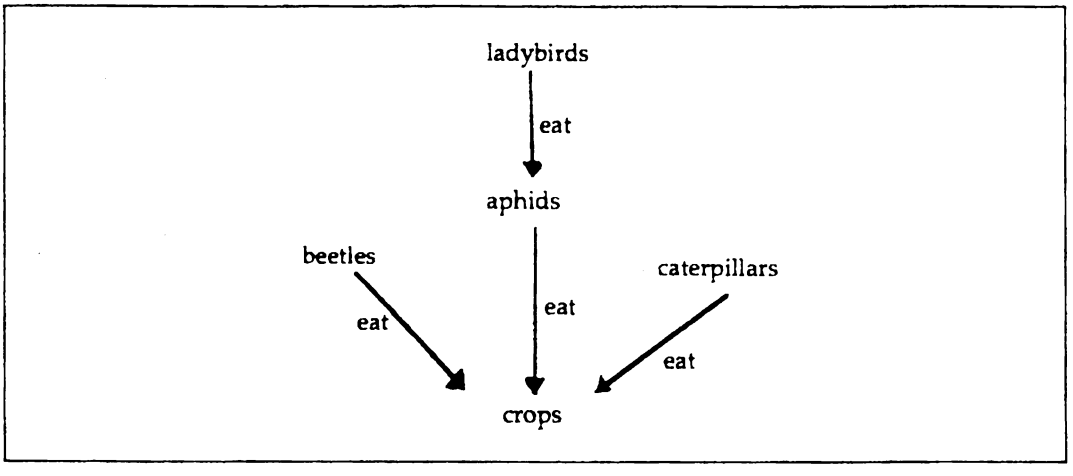
one turn:	7 cm
two turns:	18 cm
three turns:	28cm

a Make a graph of these results which would help you to say how far the car might go for four turns of the key.

b What do you think is the reason why the car goes further for more turns of the key?

Item 6

This diagram is part of a food web:



The farmer wants to protect his crops. Which of the creatures would it not be useful to kill?

- Aphids ☐
- Caterpillars ☐
- Ladybirds ☐
- Beetles ☐

Item 7

Michael made some lemonade using this recipe:

4 litres of water
2 lemons
500g of sugar
5g of dried yeast

Then someone told him that the fizziness depends upon the amount of sugar you put in. When Michael next made some lemonade he wanted to test whether this was true.

a. What should he change in the recipe?

.....

b. What should he not change?

.....

Item 8

To raise butterflies, you need their eggs and their food, and a cage to keep them in. (The food must be fresh.)

Here is some information about different kinds of butterflies:

Butterfly	Food plant	Egg colour	How many days for eggs to hatch?	Colour of caterpillar	Colour of pupa
Small tortoiseshell	nettle	green then black	5	black with white flecks	black, brown or green
Common blue	bird's foot trefoil	pearl white	10-15	green with brown line	green
Swallow-tail	fennel	yellow, then brown	6	black with white marks	green, then brown
Painted lady	spear thistle	pale green	7	grey-black	grey or green
Camberwell beauty	willow, sallow	red-brown	7	black with red blotches	brown

Use the table to help you answer these questions:

a. What is the food plant of the swallow-tail butterfly? .....

b. Which butterfly's eggs take the longest to hatch? .....

c. One butterfly lays red-brown eggs. The colour of its pupa is .....

Resource 14

These were some children's answers to Item 2 of Resource 13.

a. The number of coins goes with the span.

b. The wider the span the smaller the number of coins.

c. The wider the span the weaker the bridge.

d. The smallest one held the most.

Resource 15

Guidelines for writing test items

A. PROCESS SKILLS

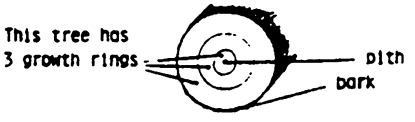
Selection of content

Items which assess process skills must have some content; a skill cannot be used in a vacuum. When the emphasis is on the process skill the content must not be a hurdle to using the skill (i.e. so unfamiliar that the question cannot be understood) nor so familiar that the answer can be given by recall.

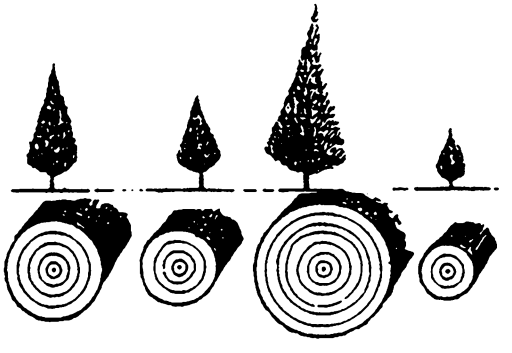
What is unfamiliar and familiar depends, of course, on the age and environment of the child. Thus a process-based question for a younger child may be straight recall for an older one. Hence it is important to consider the age of the children for whom questions are intended.

Any information that is required to be used in answering a skill-based question should be given within the question, so that success does not depend on being able to recall it. For example in the question below children are asked to find and use patterns in the heights of trees which have different numbers of rings in the trunk, given information about what is meant by rings in the trunk.

When we cut across the truck of a tree we see growth rings.



The trees below were planted at different times in the same wood. The drawings show the trees before they were cut down and, underneath, the growth rings seen after they were cut down.



What do you notice about the heights of the trees and the rings in the trunks?

.....

Process-based questions have two parts:

- **A given situation,** with necessary information
- **A request** to do something in relation to the given situation which requires the use of the intended process skill.

Here are some examples of what can be **given** and **requested** in questions assessing process skills.

Observation

Given: Something to observe (difficult in a purely written test, but could be careful drawings or photographs, or readily available simple materials).

Request: Describe similarities and difference between two objects.
Match objects to description that requires observation of fine details.
Group (drawings of) objects together according to observable features.

Hypothesising

Given: A situation or event which has no obvious single explanation.

Request: Give two possible explanations.

Predicting

Given: Observations or data in which a trend or pattern can be detected and then used to make a prediction in the form of an extrapolation or interpolation.

Request: To say what will happen if some specified change is made in one of the variables.

Planning investigations

Given: A question or problem which can be investigated by changing one variable and controlling others. (Note that only the planning of the investigation and not the control of variables in practice can be assessed in a written test.)

Request: Outline the investigation to be carried out, either as a whole or one specified part of it (eg which variables to be held constant, which changed, what to be measured or observed).

Interpreting/drawing conclusions

Given: Some data which contains a pattern or relationship between two variables

Request: Find the pattern or relationship which encompasses all the available data.
Decide whether there is evidence in the data that supports a given conclusion.

Communicating

Given: Data in numerical, tabular, graphical or diagrammatic form.

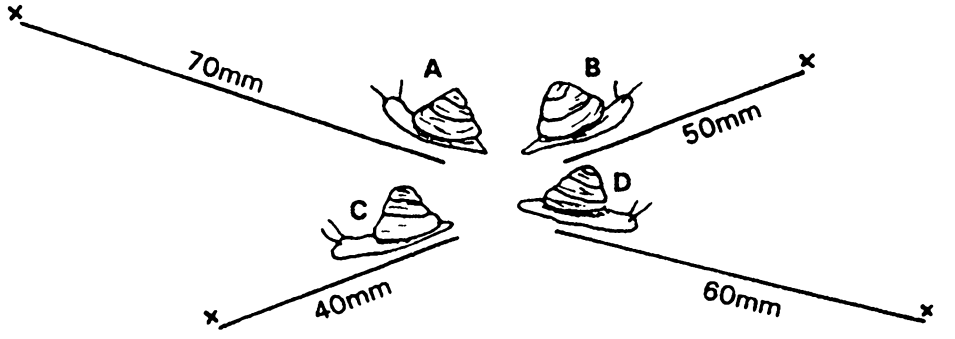
Request: Read off data or add more data or change data from one form to another.

B. UNDERSTANDING OF CONCEPTS

Understanding an idea or concept means being able to use it in situations other than that in which it was learned, that is, to apply it to new situations and in some case to transform it. In this example, it is necessary to know that speed is distance travelled in a certain time. Without this information the question cannot be answered. Although part b) asks for a prediction, being able to predict would not help if a person does not have an understanding of speed. Thus the question assesses the concept and not the ability to use given information to make a prediction.

How fast do snails go?

To find out John and Pamela put four snails down next to each other and marked their trails. They put a cross(x) where each snail had reached after 30 seconds.



a. Which snail went fastest?

.....

b. If snail C went on at the same speed for another 15 seconds, how far would it go beyond x?

.....

Given: A situation in which there is something to be explained by the application (not straight recall) of a scientific concept.

Request: Give an explanation.
Make a prediction and explain the reason for it