THINKING AND REASONING SKILLS

SKILL 9: INFORMATION PROCESSING AND PROBLEM SOLVING

Of all the ten skills in the Thinking and Reasoning Skills course, this one is probably the most fun. Not only that, but it can be practised in connection with any of the other skills.

It is important in many contexts to be able to look at information (whether numerical or verbal) with a critical eye, so as to draw from it only the relevant and useful information. Being able to recognise valid patterns in data is also useful, as is being able to apply strategies to solve problems in an organised way. Only when we have mastered these skills, can we start to draw valid conclusions from information we are presented with.

By teaching and assessing this skill, the aims and objectives are as follows:

IDENTIFYING RELEVANT INFORMATION

Teachers should aim to:
Expose students to a range of ways in which information can be presented (arguments, graphs, tables, statistics).
Give students practice and guidance in sorting information according to relevance, and answering questions that involve drawing information from data.

STUDENTS SHOULD BE ABLE TO:

Put jumbled information in order.
Answer specific questions based on information presented in different ways.

RECOGNISING PATTERNS

Give students practice and guidance in solving a range of puzzles (numerical and verbal) that involve identifying and applying patterns.
Explain 'pattern' as distinct from mere 'similarity'.
Give guidance in spotting more than one pattern in data without repetition.

STUDENTS SHOULD BE ABLE TO:

Spot and explain patterns in data.
Use patterns to help you solve puzzles.

PROBLEM SOLVING USING MATRICES

Explain how a matrix can work as a strategy for solving problems.
Give students practice and guidance in using matrices to solve problems at different levels of difficulty.

STUDENTS SHOULD BE ABLE TO:

Use a matrix to solve a problem in which you have to match up different elements.

DRAWING CONCLUSIONS FROM DATA

Teachers should aim to:
Give students practice and guidance in drawing conclusions from specific data.
Expose students to examples of conclusions drawn from data and give guidance on how to judge whether or not they are supported by the data.

STUDENTS SHOULD BE ABLE TO:

Choose the conclusion that is best supported by specific data.
Give reasons why a certain conclusion is not supported well by data.
Suggest conclusions that could be drawn from specific data.

IDENTIFYING RELEVANT INFORMATION

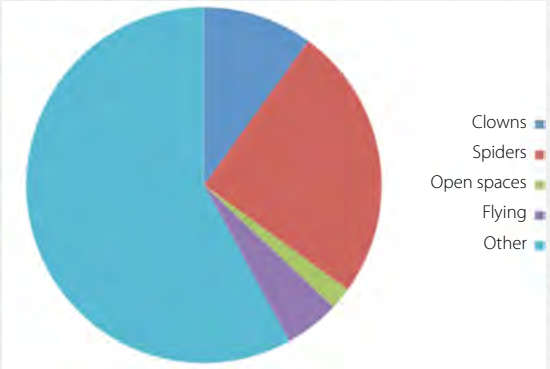
Information (facts derived from experience, research or study) can be presented in lots of different ways. For example, it might be presented in a table like this one:

Table to show what people are most afraid of

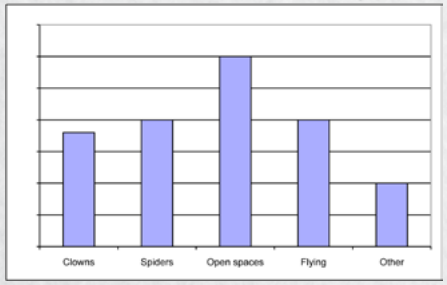
	Clowns	Spiders	Open spaces	Flying
% of people asked	10	25	2	5

This is a very simple way of presenting statistics, which can then be turned into a graph or a pie-chart, for example:

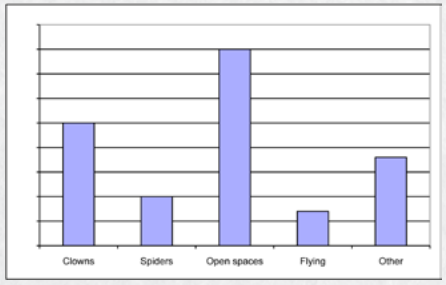
% of people



Task: the following graphs are not labelled correctly, making them difficult to read. Based on the limited information presented, which one correctly presents the information given in the table above?



1



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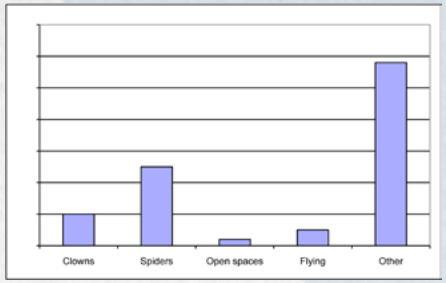

3

Even though there are no numbers or labels on any of these three graphs, we can see from the size of the columns that only one of them matches with the differences between the four figures. The answer is B.

When we are trying to find a match between two different things, what we are looking for is **relevance** – in other words, a meaningful connection.

In the following activity, you are asked to put three jumbled up arguments back together so that you are left with three arguments that make sense. What you are doing here is selecting the sentences that have *relevance* to each of the arguments. To do this, you will need to scan the text and this is made easier if you focus on one thing at a time. For example, start by reading down the text for anything that is relevant to school uniforms and highlight it, then do voting and so on :

The following support materials can be found within the **Skill 9 pdf portfolio**.

9.01 Jigsaw printable worksheet.doc

9.02 Jigsaw answers.doc

Data can be a useful source of information, and is often used as evidence to support an argument. For example:

Parents should not hire clowns for entertainment at their children's parties, because they are really scary. This is supported by a recent nationwide urvey, which revealed that 10% of people asked were more afraid of clowns than anything else, which supports this statement.

To draw useful information out of data is not always easy, as lots of it is often not very useful at all, or is irrelevant to what you are trying to show. This activity will give you some practice in working with data to draw information that could be useful in reaching a conclusion:

The following support materials can be found within the **Skill 9 pdf portfolio**.

9.03 Results data printable worksheet.doc

9.04 Results data answers.ppt

Taking it further: Present an argument of your own using information drawn from the GCSE results data as evidence to support your reasoning.

Being able to recognise whether evidence supports a particular claim, as well as work out what claims it actually supports is not always easy. This activity will help you practice this;

9.05 Evidence sorting Printable worksheet.docx

9.06 Evidence sorting answers.docx

RECOGNISING PATTERNS

It is not always easy to spot patterns in data, but it is a useful way of drawing information from a specific set of data that can be used to make further predictions or general claims. For example, consider the data below based on the favourite historical character of some students in a 6th form History class:

Name of student	Gender	GCSE History grade achieved	Favourite Historical character	Least favourite historical character
John	Male	A*	Martin Luther King	Pol Pot
Claire	Female	A	Alexander the Great	Julius Caesar
Sarah	Female	B	Alexander the Great	Oliver Cromwell
Jeremy	Male	C	Henry VIII	Oliver Cromwell
Harris	Male	A*	Martin Luther King	Pol Pot

In order to make any use of this data, we need to analyse it for patterns. A pattern exists when there is something common to more than one feature of the data, which is not contradicted. So, for example, we can see that both John and Jeremy achieved A* in GCSE history, but we cannot say that 'All the boys achieved A* in GCSE History', because this is contradicted by the data for Jeremy. We can, however, say 'Only boys achieved A* in GCSE History' – this is a pattern that can be observed in this data.

Task: Which of the following are accurate statements of patterns that can be seen in this data?

A. People called Jeremy like Henry VIII

B. People who favour Martin Luther King have Pol Pot as their least favourite character.

C. Girls favour Alexander the Great as a historical character.

D. Boys' least favourite historical character is Pol Pot

E. People who got an A*in GCSE History favour Martin Luther King as a historical character.

Only of these statements accurately identify a pattern that can be seen in this data.

- Two of the statements (A and F) are not patterns at all because they are only based on one instance – to be a pattern we need to see it occur more than once.
- One of the statements (D) is not a pattern either, because it is contradicted by the fact that Jeremy gave Oliver Cromwell as his least favourite.
- B, C and E all identify patterns that can be seen in this data.

Puzzles which make use of patterns are a good way to practice working your brain in this way:

The following support materials can be found within the **Skill 9 pdf portfolio**.

9.07 Puzzle printable worksheet.doc

9.08 Puzzle Solution.ppt

PROBLEM SOLVING USING MATRICES

Some puzzles give a set number of clues, and require you to match up different variables. For example:

Fran, Geoff, Holly and Josh have ordered pizza, but they all prefer different toppings: one likes Pepperoni, one will only eat a Margherita, one loves Ham and Pineapple and one is a big fan of Meat Feast (this is not in any particular order).

Use the information provided below to identify which person has ordered which pizza:

1. Both Josh and the Pepperoni eater are in the same class as the person who likes Ham and Pineapple at school.
2. Holly has never met Geoff.
3. The Pepperoni eater has been working with Fran to buy a surprise Birthday present for Holly.
4. Holly and Geoff were not there when the margherita lover ate a 14" deep pan all to themselves.

The best way of solving a problem like this is by eliminating as you go along, which can lead to some very muddled thoughts. This is where a matrix comes in very useful, which gives you a framework to organize the process of elimination as you work through the clues. You put a cross in the section as you eliminate it. So, the first clue tells us that Josh is not the pepperoni or the ham and pineapple eater, so a cross has been placed in the sections where those variables meet.

	Pepperoni	Margherita	Ham and Pineapple	Meat Feast
Fran				
Geoff				
Holly				
Josh	X		X	

Task: Complete the matrix by using the remaining clues and putting crosses next to the matches you eliminate and ticks next to those you find matches for.

Show answers: ?

These practice activities are in order of difficulty, from easiest to most difficult:

The following support materials can be found within the **Skill 9 pdf portfolio**.

9.09 How to use a matrix to solve a problem.ppt

9.10 The Colours Election printable worksheet.doc

9.11 The Colours Election - Solution.doc

9.12 Track & Field printable worksheet.doc

9.13 Track and Field Solution.ppt

9.14 Ten Teacher Teaser Task printable worksheet.doc

9.15 The Ten Teacher Teaser Task Solution.ppt

DRAWING CONCLUSIONS FROM DATA

When we present an argument, we have learned how important it is to make sure that the conclusion is well supported by relevant reasoning, without making any assumptions, flaws or irrelevant appeals. In the same way, when we use patterns in data to reach conclusions, we should avoid assumptions and flaws. Let's consider the data we used earlier, about favourite historical characters:

Name of student	Gender	GCSE History grade achieved	Favourite Historical character	Least favourite historical character
John	Male	A*	Martin Luther King	Pol Pot
Claire	Female	A	Alexander the Great	Julius Caesar
Sarah	Female	B	Alexander the Great	Oliver Cromwell
Jeremy	Male	C	Henry VIII	Oliver Cromwell
Harris	Male	A*	Martin Luther King	Pol Pot

We established that three valid patterns were:

- People who favour Martin Luther King have Pol Pot as their least favourite character.
- Girls favour Alexander the Great as a historical character.
- People who got an A*in GCSE History favour Martin Luther King as a historical character.

Task: Which of the following conclusions could be accurately drawn from this information?

A. Students who like Martin Luther King are more likely to get an A* in GCSE History

B. A new female student joining the class will favour Alexander the Great

C. Alexander the Great is more popular among history students than Pol Pot.

A cannot be drawn, because there is no way of knowing whether they favoured Martin Luther King before or after achieving their A* in GCSE History.
B cannot be drawn, because we cannot assume that teh two girls in this samples are representative of all female history students, and also because the new student may have an A* in History so even if we accept this logic, she may well favour Martin Luther King.
C could be drawn, as long as we accept that this group is a representative sample.

As we have seen, data can come in a variety of forms. So, when you are presented with numerical data and you are asked to reach a conclusion, the trick is to use thinking and reasoning skills systematically rather than to think of it as a mathematical problem.

Here are some practice exercises to work through:

The following support materials can be found within the **Skill 9 pdf portfolio**.

9.16 Euro 2004 printable worksheet.doc

9.17 The Colours Election - Solution.doc

This exercise is more challenging, but is good practice:

9.18 Double Trouble printable worksheet.docx

9.19 Double Trouble answers.docx

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