

# Numeracy



# Numeracy

REVISED EDITION

## **ACKNOWLEDGMENTS**

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# About the BC Performance Standards

**T**he BC performance standards have been developed for voluntary use in BC schools. They describe the professional judgments of a significant number of BC educators about standards and expectations for the following key areas of learning:

- ◆ reading
- ◆ writing
- ◆ numeracy
- ◆ social responsibility

The standards focus exclusively on *performance assessment*. In performance assessment students are asked to apply the skills and concepts they have learned to complete complex, realistic tasks. This type of assessment supports a criterion-referenced approach to evaluation and enables teachers, students, and parents to compare student performance to provincial standards.

The BC performance standards are intended as a resource to support ongoing instruction and assessment. Teachers can use these standards to:

- ◆ monitor, evaluate, and report on individual student performance
- ◆ identify students who may benefit from intervention
- ◆ develop a profile of a class or group of students to support instructional decision-making
- ◆ prompt discussions with parents, students, and other teachers about student performance
- ◆ inform professional development activities
- ◆ collaboratively set goals for individuals, classes, or schools
- ◆ develop evidence for school growth plans
- ◆ provide models for designing performance tasks

**Performance  
standards  
support ongoing  
instruction and  
assessment.**

**The BC  
performance  
standards  
complement  
existing  
curricula and  
assessment  
materials  
developed by  
the Ministry  
of Education.**

## Ongoing Development

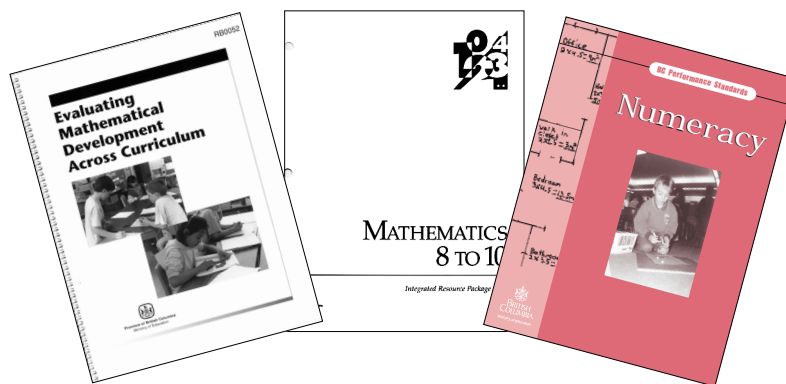
### REFERENCE SET CONNECTION

The BC performance standards are a continuation of the work begun in the provincial reference sets.

Starting in 1991, the province developed reference sets for reading, writing, mathematical development, group communication skills, and problem solving. The reference sets show the broad range of possible student development in each of these essential skill areas. They can be used to evaluate student work in any subject.

The BC performance standards work within these same ranges of development in the same areas. They can also be used to evaluate these skills in any subject. However, the standards focus on levels of performance at particular grades.

For both sets of documents, teachers used their experience and student work to develop and validate the materials. Both also use student work and teacher comments to illustrate and describe levels of performance.



### LEARNING OUTCOMES

Learning outcomes describe what students are supposed to learn in each subject and at each grade level. Learning outcomes are often called *content standards*. Content standards answer the question: “What knowledge, skills, and attitudes are students expected to develop at this grade level?”

The ministry’s Integrated Resource Packages list prescribed learning outcomes for BC provincial curricula for each subject and grade level.

## Ongoing Development

### **PERFORMANCE STANDARDS**

Performance standards describe levels of achievement in key areas of learning. Performance standards answer the questions: “How good is *good enough*? What does it look like when a student’s work has met the expectations at this grade level?”

The BC performance standards describe and illustrate the following four levels of student performance in terms of prescribed learning outcomes relevant to the key areas of reading, writing, numeracy, and social responsibility.

### **NOT YET WITHIN EXPECTATIONS**

- ◆ the work does not meet grade-level expectations
- ◆ there is little evidence of progress toward the relevant prescribed learning outcomes
- ◆ the situation needs intervention

### **MEETS EXPECTATIONS (MINIMAL LEVEL)**

- ◆ the work may be inconsistent, but meets grade-level expectations at a minimal level
- ◆ there is evidence of progress toward relevant prescribed learning outcomes
- ◆ the student needs support in some areas

### **FULLY MEETS EXPECTATIONS**

- ◆ the work meets grade-level expectations
- ◆ there is evidence that relevant prescribed learning outcomes have been accomplished

### **EXCEEDS EXPECTATIONS**

- ◆ the work exceeds grade-level expectations in significant ways
- ◆ the student may benefit from extra challenges

**The standards describe and illustrate four levels of performance.**



## Key Components

These key components are included for each grade level.

**Rating Scale.** This is the full version of the performance standards, with the four performance levels described in detail.

Rating Scale: Grade 4 Numeracy				
These scales may apply at any time of the year, depending when specific skills or concepts are introduced.*				
Aspect	Not Yet Within Expectations	Meets Expectations (Minimal Level)	Fully Meets Expectations	Exceeds Expectations
<b>KNOWLEDGE AND APPLICATION</b> • identifying mathematical concepts and procedures needed to solve problems or complete tasks that have been modelled in class • work to inaccurate or incomplete • may need one-to-one support to identify simple patterns and relationships • patterns, relationships	• may be unable to identify the basic concepts and procedures needed to solve problems or complete tasks that have been modelled in class • work to inaccurate or incomplete • may need one-to-one support to identify simple patterns and relationships • patterns, relationships	• identifies some of the concepts and procedures needed to solve problems or complete tasks that have been modelled in class • applies most relevant mathematical concepts and skills appropriately; work is incomplete or includes some errors • identifies simple patterns and relationships; may need help using how to use them (e.g., to make predictions)	• identifies concepts and procedures needed to solve problems or complete tasks that have been modelled in class • applies relevant mathematical concepts and skills appropriately; work is complete or includes minor errors or omissions • identifies, explains, and uses patterns and relationships (e.g., to make predictions)	• identifies concepts and procedures needed to solve problems or complete tasks that have been modelled in class • applies relevant mathematical concepts and skills appropriately and efficiently; precise identifies, explains, and uses patterns and relationships (e.g., to make predictions, create shortcuts) may reduce task patterns
<b>STRATEGIC APPROACHES</b> • problem • problem to early solution	• cannot break the task into steps, units, or sections • unable to verify results or solutions by using estimation, inverse operations, or a calculator	• attempts to break the task into steps or units or adjust procedures • needs help to use estimation, inverse operations, or a calculator to verify results or solutions	• structures the task logically, breaking it into steps or stages, but may be inefficient • if asked, verifies results or solutions by using estimation, inverse operations, or a calculator	• structures the task effectively, breaking it into logical steps or stages • may independently verify results or solutions by using estimation, inverse operations, or a calculator
<b>ACCURACY</b> • recording calculations	• may include major errors in recording or calculation (addition and subtraction to 10,000; multiplication of three-digit by one-digit numbers; division of two-digit by one-digit numbers)	• may include some recording or calculation errors (addition and subtraction to 10,000; multiplication of three-digit by one-digit numbers; division of two-digit by one-digit numbers); comparisons are generally reasonable	• recording and calculations are generally accurate, including units (inverse some addition and subtraction to 10,000; multiplication of three-digit by one-digit numbers; division of two-digit by one-digit numbers)	• all recording and calculations are accurate, including units (inverse some addition and subtraction to 10,000; multiplication of three-digit by one-digit numbers; division of two-digit by one-digit numbers)
<b>PRESENTATION AND COMMUNICATION</b> • presenting work • explaining procedures and results • problem, results	• work may be unclear and confusing • work may not be well organized (tables, charts, graphs, diagrams, etc.) • may include some errors in recording or calculation (addition and subtraction to 10,000; multiplication of three-digit by one-digit numbers; division of two-digit by one-digit numbers) • may be unable to explain procedures and results, when required	• work may be confusing to others • work may not be well organized (tables, charts, graphs, diagrams, etc.) • may include some errors in recording or calculation (addition and subtraction to 10,000; multiplication of three-digit by one-digit numbers; division of two-digit by one-digit numbers) • may be unable to explain procedures and results, when required	• work is generally clear and easy to follow; may be well organized (tables, charts, graphs, diagrams, etc.) • may include some errors in recording or calculation (addition and subtraction to 10,000; multiplication of three-digit by one-digit numbers; division of two-digit by one-digit numbers) • may be unable to explain procedures and results, when required	• work is clear and easy to follow • work may be well organized (tables, charts, graphs, diagrams, etc.) • may include some errors in recording or calculation (addition and subtraction to 10,000; multiplication of three-digit by one-digit numbers; division of two-digit by one-digit numbers) • may be unable to explain procedures and results, when required

Quick Scale: Grade 4 Numeracy				
This Quick Scale is a summary of the criteria described in detail in the Rating Scale that follows. These criteria may apply at any time of the year, depending when specific skills or concepts are introduced.*				
Aspect	Not Yet Within Expectations	Meets Expectations (Minimal Level)	Fully Meets Expectations	Exceeds Expectations
<b>KNOWLEDGE AND APPLICATION</b> • identifying mathematical concepts and procedures needed to solve problems or complete tasks that have been modelled in class • work to inaccurate or incomplete • may need one-to-one support to identify simple patterns and relationships • patterns, relationships	• may be unable to identify the basic concepts and procedures needed to solve problems or complete tasks that have been modelled in class • work to inaccurate or incomplete • may need one-to-one support to identify simple patterns and relationships • patterns, relationships	• identifies some of the concepts and procedures needed to solve problems or complete tasks that have been modelled in class • applies most relevant mathematical concepts and skills appropriately; work is incomplete or includes some errors • identifies simple patterns and relationships; may need help using how to use them (e.g., to make predictions)	• identifies concepts and procedures needed to solve problems or complete tasks that have been modelled in class • applies relevant mathematical concepts and skills appropriately; work is complete or includes minor errors or omissions • identifies, explains, and uses patterns and relationships (e.g., to make predictions)	• identifies concepts and procedures needed to solve problems or complete tasks that have been modelled in class • applies relevant mathematical concepts and skills appropriately and efficiently; precise identifies, explains, and uses patterns and relationships (e.g., to make predictions, create shortcuts) may reduce task patterns
<b>STRATEGIC APPROACHES</b> • problem • problem to early solution	• cannot break the task into steps, units, or sections • unable to verify results or solutions	• attempts to break the task into steps or units or adjust procedures • needs help to use estimation, inverse operations, or a calculator to verify results or solutions	• structures the task logically, breaking it into steps or stages, but may be inefficient • if asked, verifies results or solutions by using estimation, inverse operations, or a calculator	• structures the task effectively, breaking it into logical steps or stages • may independently verify results or solutions by using estimation, inverse operations, or a calculator
<b>ACCURACY</b> • recording calculations	• may include major errors in recording or calculation (addition and subtraction to 10,000; multiplication of three-digit by one-digit numbers; division of two-digit by one-digit numbers)	• may include some recording or calculation errors (addition and subtraction to 10,000; multiplication of three-digit by one-digit numbers; division of two-digit by one-digit numbers); comparisons are generally reasonable	• recording and calculations are generally accurate, including units (inverse some addition and subtraction to 10,000; multiplication of three-digit by one-digit numbers; division of two-digit by one-digit numbers)	• all recording and calculations are accurate, including units (inverse some addition and subtraction to 10,000; multiplication of three-digit by one-digit numbers; division of two-digit by one-digit numbers)
<b>PRESENTATION AND COMMUNICATION</b> • presenting work • explaining procedures and results • problem, results	• work may be unclear and confusing • work may not be well organized (tables, charts, graphs, diagrams, etc.) • may include some errors in recording or calculation (addition and subtraction to 10,000; multiplication of three-digit by one-digit numbers; division of two-digit by one-digit numbers) • may be unable to explain procedures and results, when required	• work may be confusing to others • work may not be well organized (tables, charts, graphs, diagrams, etc.) • may include some errors in recording or calculation (addition and subtraction to 10,000; multiplication of three-digit by one-digit numbers; division of two-digit by one-digit numbers) • may be unable to explain procedures and results, when required	• work is generally clear and easy to follow • work may be well organized (tables, charts, graphs, diagrams, etc.) • may include some errors in recording or calculation (addition and subtraction to 10,000; multiplication of three-digit by one-digit numbers; division of two-digit by one-digit numbers) • may be unable to explain procedures and results, when required	• work is clear and easy to follow • work may be well organized (tables, charts, graphs, diagrams, etc.) • may include some errors in recording or calculation (addition and subtraction to 10,000; multiplication of three-digit by one-digit numbers; division of two-digit by one-digit numbers) • may be unable to explain procedures and results, when required

**Quick Scale.** This is a short-form summary of the *Rating Scale*. *Quick Scales* are intended for daily use. Teachers may also want to share them with students and parents.

**Sample Tasks.** These are tasks developed by practising teachers to provide opportunities to assess student work in the skill area. Each sample task includes examples of student work. Teachers may use the tasks as given or as models. Any tasks used should first be reviewed for issues sensitive to the class or community.

Additional sample tasks, student work, and other support materials are available at the Ministry of Education's web site.

Sample 1: Conducting Surveys (Data Analysis)	
<b>CONTEXT</b> This was the culminating activity in a data collection unit. During the unit, the teacher modelled and provided several opportunities for students to practice matching questions to a sample population, collecting data, and constructing and analyzing graphs.	
<b>MATHEMATICAL CONCEPTS</b> • select appropriate sample or population • collect first- and second-hand data • create interval graphs (tables) • construct bar graphs • evaluate data collection processes	
<b>PROCESSES</b> The class reviewed what they had learned about conducting surveys and communicating the results. The teacher explained that for this survey each student would choose his or her own question and work independently to collect and display the data. The class brainstormed some possible questions.  Students then worked independently to: 1. Choose a survey topic. 2. Survey the sample population (usually their classmates) and tally the results. 3. Create a bar graph to display the data collected. 4. Analyze the data; write a short summary of the results (e.g., range, most frequent choice, number of people). 5. Evaluate the survey (e.g., comment on the sample and the data collected). 6. Post the work around the room for other students to view.  The class discussed what they had learned and commented on ways that their project was similar and different. They also developed a list of "tips" for collecting and displaying data, which the teacher posted for future reference. For the remainder of the school year, the teacher encouraged students to look for situations where they could collect and report on data to other subject areas.	

# Student Samples

1
MEETS EXPECTATIONS (MINIMAL LEVEL)

2
Teacher's Observations  
The data collection and display meets most basic requirements of the task, but the explanation is confusing and does not deal with the mathematical aspects of the task.

- identifies some of the concepts and procedures needed
- applies most relevant mathematical concepts and skills appropriately; work is incomplete
- required tables and graphs are generally accurate
- explanations and conclusions are incomplete

3

	Identify	Explain	Justify	Conclude
Identify				
Explain				
Justify				
Conclude				

4

GRADE 4 NUMERACY

51

For each task there is one example of student work at each of the four levels.

- Level of Work.**
- Teacher's Observations.** These are additional comments by the teacher and key relevant criteria from the *Rating Scale*.
- Rating Scale Icon.** This is a generalized summary of the scale completed by the teacher. Here is how the actual scale looks for this sample:

Rating Scale: Grade 4 Numeracy					
These criteria may apply at any time of the year, depending upon grade, skill or concept, or situation. *					
Aspect	Not Yet Within Expectations	Meets Expectations (Minimal Level)	Fully Meets Expectations	Exceeds Expectations	
<b>KNOWLEDGE</b> The student may be unable to complete the task without ongoing help; cannot follow procedures independently.	The work satisfies most basic requirements of the task, but it is flawed or incomplete in some way. The student may need some help.	The work is complete and accurate (may include minor flaws or errors). The student is able to develop a simple extension of the same mathematical idea.	The work is complete, accurate, and efficient. The student may find an alternative or shortcut, or develop an extension or additional application of the same mathematical idea.		
<b>CONCEPTS AND APPLICATIONS</b> • may be unable to identify the basic concepts and procedures needed to solve problems or complete tasks that have been modified in class • work is incomplete or incomplete • may need one to one support to identify simple patterns and relationships	• identifies some of the concepts and procedures needed to solve problems or complete tasks that have been modified in class • applies most relevant mathematical concepts and skills appropriately; work is incomplete or includes some errors • identifies simple patterns and relationships (e.g., to make predictions)	• identifies concepts and procedures needed to solve problems or complete tasks that have been modified in class • applies relevant mathematical concepts and skills appropriately; may be somewhat inefficient or make minor errors or omissions • identifies, explains, and uses patterns and relationships (e.g., to make predictions)	• identifies concepts and procedures needed to solve problems or complete tasks that have been modified in class • applies relevant mathematical concepts and skills appropriately and efficiently; precise • identifies, explains, and uses patterns and relationships (e.g., to make predictions, create shortcuts); may notice subtle patterns		
<b>STRATEGIES AND EFFICIENCY</b> • problem • solution • solution to early solution	• cannot break the task into steps, stages, or sections • problem • solution to early solution	• attempts to follow instructions, does not check or adjust procedures • needs help to use estimation, inverse operations, or a calculator to verify results or solutions	• structures the task logically breaking it into steps or stages, but may be inefficient • if asked, confirms results or solutions by using estimation, inverse operations, or a calculator	• structures the task efficiently breaking it into logical steps or stages • may independently verify results or solutions by using estimation, inverse operations, or a calculator	
<b>ACCURACY</b> • recording • calculation	• may include major errors in recording or calculations (addition and subtraction to 10,000; multiplication of three-digit by one-digit numbers; division of two-digit by one-digit numbers)	• may include some recording or calculation errors (addition and subtraction to 10,000; multiplication of three-digit by one-digit numbers; division of two-digit by one-digit numbers); comparisons are generally reasonable	• recording and calculations are generally accurate, including units; may include minor errors (addition and subtraction to 10,000; multiplication of three-digit by one-digit numbers; division of two-digit by one-digit numbers)	• all recording and calculations are accurate, including units (inverse some tolerance for minor errors); may use mental math to arrive at a solution quickly	
<b>REPRESENTATION AND COMMUNICATION</b> • presenting work • connecting data • diagrams, displays • explaining • conclusions, results	• work may be unclear and confusing • may omit required tables, charts, shapes, nets, bar graphs, and paragraphs; these procedures may be inappropriate, inaccurate, or incomplete • may be unable to explain procedures and results; often illogical	• work may be confusing in places • includes most required tables, charts, shapes, nets, bar graphs, and paragraphs, but may be inaccurate or include some errors • explanations and conclusions may be incomplete; includes little mathematical language	• work is generally clear and easy to follow (may be somewhat unclear in places) • required tables, charts, diagrams, or graphs are generally accurate, including labels and titles; may have minor errors or omissions; particularly in more complex tasks • often logical explanations and conclusions; uses some mathematical language (e.g., add, up, estimated, equal)	• work is clear and easy to follow • required tables, charts, diagrams, or graphs are accurate and complete, including labels and titles; may have minor errors, particularly in more complex tasks; may voluntarily include features that help to clarify the task or result • often logical explanations and conclusions; uses appropriate mathematical language; often detailed and insightful	

- Student Work.** This shows a reproduction of the student's work. (Names of students and teachers have been changed where this information could be used to identify individuals.)

**The BC  
performance  
standards can  
contribute to a  
comprehensive  
assessment and  
evaluation  
system.**

## Using the Standards

**T**eachers use a variety of methods to gather the information they need to assess, evaluate, and report on student learning. Possible methods include classroom and standardized tests, observations, student work portfolios, conferences, self- and peer assessment, and performance tasks.

The BC performance standards give teachers a way to assess students' abilities to apply their learning in realistic performance tasks in the areas of reading, writing, numeracy and social responsibility. Used with other methods, they can be an important part of a comprehensive assessment and evaluation system. The standards:

- ◆ should be used within the context of ongoing classroom instruction. They are meant to be curriculum-embedded—used as part of regular classroom learning activities.
- ◆ provide resources for assessing and evaluating the quality of a specific piece or a collection of student work from various subject areas. They can help to develop a profile of student achievement, typically based on three to seven pieces of work.
- ◆ assume that in most cases teachers are observing students as they work. Often, some of the evidence needed to make decisions about a student's work comes from observations and conversations with students.
- ◆ allow for teachers to intervene where students are unable to complete a task independently. The level of assistance required is often one of the criteria for determining whether or not a student's work falls within grade-level expectations.
- ◆ may be adapted as needed. This might mean creating scales for grades not included in the standards, developing IEPs or other tailored evaluation, or adjusting expectations for different times of the year.

## Supporting Learning

**T**he BC performance standards are intended to support instructional decision-making. Teachers may want to consider the following questions as they plan instruction:

- ◆ How do these standards match my/our expectations for students at this level?
- ◆ What kinds of instructional strategies and learning opportunities will help most students develop the skills they need to meet these expectations?
- ◆ What additional support and interventions will be needed to help *all* students meet these expectations?
- ◆ If there are some students for whom these expectations are *not* appropriate, what expectations should they meet?
- ◆ What evidence do I/we need to collect to find out if students are making progress towards the expectations?

**The BC  
performance  
standards can  
be used to help  
plan instruction.**



# Numeracy in BC Schools

**N**umeracy refers to the application of mathematical understanding in daily activities at school, at home, at work, and in the community. It involves both using mathematical skills and knowing how mathematics can be used to solve problems.

Just as there is more to literacy than teaching the rules and procedures of language, there is more to numeracy than teaching the rules and procedures of mathematics. Numerate individuals not only “know” mathematics, but understand it in personally meaningful terms. They feel competent and confident about their ability to draw on the necessary knowledge and apply it in new and relevant ways.

## Numeracy and Mathematics

**N**umeracy as a skill area is currently evolving in the BC school system. The following is the understanding of the term as it is used in this document. This may be refined and adjusted as our understanding improves.

Numeracy involves concrete applications in which students, confidently and independently, use mathematics to address real tasks or problems in an increasing variety of situations. The ability to recognize the mathematical demands and possibilities in a situation is an important aspect of numeracy.

Numeracy is based on mathematical foundations and requires the application of concepts and skills related to the formal aspects of the discipline of mathematics. These formal aspects are reflected in the organizers for BC mathematics curricula:

- ◆ Number (Concepts and Operations)
- ◆ Patterns and Relations
- ◆ Shape and Space
- ◆ Statistics and Probability
- ◆ Problem Solving (Grades 8-12)

Numeracy tasks and problems typically draw on concepts and skills from two or more of the curriculum organizers listed above, and can

be grouped according to purpose or context. For example, Human Resources Development Canada describes numeracy as an *essential skill* and identifies five contexts or applications in which adults are required to apply mathematical concepts and skills in the workplace:

- ◆ money math
- ◆ scheduling or budgeting and accounting math
- ◆ measurement and calculation math
- ◆ data analysis math (including chance)
- ◆ numerical estimation

### Part of a Comprehensive Picture

**T**he BC performance standards for numeracy can be used to evaluate students' abilities to use the mathematics they have learned to address concrete, practical, and age-appropriate tasks and problems. The performance standards do *not* address all aspects of the mathematics curricula and need to be used in combination with other forms of assessment to develop a comprehensive picture of student achievement in the BC mathematics curricula.

Although this document currently includes only grades 1 through 8, it is the intention that numeracy be a focus in BC classrooms from Kindergarten to Senior Secondary. Work is ongoing in this area.

### Curriculum Connection

**I**n BC schools, primary responsibility for developing and evaluating mathematical skills is assigned to mathematics. Depending on the tasks developed or selected, using the numeracy standards can help teachers address a wide range of outcomes from the provincial mathematics curricula.

However, students are expected to apply and extend their numeracy skills in a variety of content areas (e.g., map reading/making in social studies; constructing/interpreting data tables and graphs in science; data analysis and evaluation in areas such as history, English language arts, and career and personal planning; tracking progress in physical education; using perspective in visual arts). The performance standards for numeracy have therefore also been developed to apply in all curriculum areas.

## Aspects of Numeracy

The performance standards focus on four aspects of numeracy, as described here.

### CONCEPTS AND APPLICATIONS

- ◆ recognizing the mathematical demands and possibilities in a situation or task
- ◆ applying grade-specific concepts and skills
- ◆ recognizing and using patterns and relationships

Evidence comes from observing and talking to students and analyzing their work. In school, many numeracy tasks simulate real applications (rather than having students find problems to solve on their own) and thus do not provide evidence of ability to recognize the mathematical possibilities in a situation.

### STRATEGIES AND APPROACHES

- ◆ structuring the task into logical steps or stages
- ◆ verifying solutions

Evidence comes from observing and talking to students and analyzing their work. With younger students, most evidence comes from observation. Older students may clearly demonstrate these features in their written work if the task is structured to require it.

### ACCURACY

- ◆ recording and calculations

Evidence comes from examining student work.

### REPRESENTATION AND COMMUNICATION

- ◆ presenting work
- ◆ constructing charts, tables, diagrams, and displays
- ◆ explaining procedures and results

Evidence of presentation and construction comes from examining student work. It is usually necessary to prompt students to specifically explain procedures and results. Evidence of this aspect is most effectively gathered through conferences; however, students can also provide written explanations.



