
Assessment and Evaluation

Assessment, Evaluation, and Grading

These three terms represent related but distinct processes.

Assessment involves gathering information about student performance using various strategies and tools. The main purpose of assessment is to improve student learning. The most important aspect of assessment is providing feedback to students about what they need to improve, and ways they might address those areas for improvement. Teachers assess students by having them show what they know and can do, through the use of multiple forms of assessment. Assessment data can be recorded as quantitative data (numeric scores, letter grades, and so on) or as qualitative data (comments, observations, and so on). Assessment is also critical from the teacher's perspective since it provides important information about how the teacher needs to modify instruction for the whole class, group, or individual.

Evaluation refers to the process of judging student work and achievement according to established criteria and standards, such as are set out in the Achievement Chart. Evaluation should be based on assessment data that has been gathered over time and should only occur once students have had practice, feedback, and time to improve. An evaluation statement is a considered, expert judgement that the teacher bases on a significant accumulation of data about student performance over an appropriate period of time. Evaluation informs students, parents, and administrators about the quality of students' work related to a known set of standards.

Grading refers to the shorthand or coding system that teachers use to summarize a large amount of evaluation information for reporting purposes. Grades are expressed as percentages or letters (A, B, C, and so on) and are referenced directly to the provincial achievement charts.

The Purpose of Assessment

The main purpose of assessment is to improve student learning. It is not intended to simply audit student learning but rather to provide students, teachers, and parents with feedback that will help the student achieve success.

Quality assessment should:

- motivate students to improve learning;
- identify areas and strategies for improvement in learning and teaching;
- inform teachers about the effectiveness of instruction.

The process of assessment and evaluation should:

- have a clearly identified purpose;
- be fair to all students;
- respect students' individual needs and interests;
- provide various ways for students to show what they know and can do (performance tasks, journals, presentations, tests, assignments, and so on)

Expanding the Vision of Assessment in Mathematics

Mathematics teaching is more challenging now than it has ever been. Students in a mathematics classroom are required to:

- perform algorithm computations proficiently;
- understand mathematical concepts;
- make connections between mathematics and their world;
- develop learning skills;
- create and test conjectures;
- communicate mathematically;
- create mathematical models and apply them to solve problems;
- draw and justify conclusions orally and in writing; and
- draw out the “big ideas” of mathematics through teacher facilitation.

A paper and pencil test is just one assessment method. A variety of assessment strategies is required to assess knowledge and understanding; thinking and inquiry skills; communication; and application of knowledge as well as to ensure that students with all learning styles are assessed in an appropriate manner.

Assessment Terminology

If assessment is to help students learn, then it is important to understand the different purposes served by diagnostic, formative, and summative assessment.

Diagnostic Assessment – Diagnostic assessment identifies what students know and can do before instruction and identifies areas where students require more instruction and practice. Further, diagnostic assessment:

- occurs at or near the beginning of a unit, when new skills and concepts are being introduced;
- helps the teacher make important instructional decisions based on what students already know and can do;
- should not be counted toward a student’s report card grade.

Formative Assessment – Formative assessment provides feedback to students on their progress and suggests how they could improve performance. It should be done continuously throughout the course. Further, formative assessment:

- is most helpful when the feedback tells students what they are doing well and what they can do to improve;
- directs students toward quality work;
- provides data for evaluation purposes.

Summative Assessment – Summative assessment occurs toward the end of a unit or course. Further, summative assessment:

- provides opportunities for students to synthesize their knowledge and skills in a more complex performance;
- represents the essential learning (“big ideas”) of the unit or course;
- provides significant data for evaluation data.

Thus, assessment is a cycle of diagnosing strengths and needs; giving feedback to build and improve; and evaluating based on synthesizing assessment data about student progress with the essential learning of the unit.

Assessment Strategies and Tools

Several terms are used for strategies and tools.

Checklist – A checklist is a form that is used to keep track of a student’s work or progress. A student might find a checklist useful to ensure that all the requirements of a task are completed. A checklist is often very simple and indicates whether a behaviour, item, or characteristic is present.

Culminating Task – A culminating task often occurs at the end of a unit or term, and requires that students integrate their knowledge and skills to solve a complex, multi-stage problem or task. This could take the form of a performance assessment, assignment, or project.

Performance Assessment – Performance assessment requires students to perform, create, produce, or investigate something. It attempts to tap higher-level thinking and problem-solving skills. In contrast to traditional forms of assessment, performance assessments are not scored “correct” or “incorrect” by comparison to an answer key but instead require the teacher to apply scoring criteria to determine levels of performance. Some examples of performance assessment include open-ended problem-solving questions, investigations, and experiments.

Portfolio – A portfolio holds evidence of a student’s skills, ideas, achievements, interests, and reflections. In addition to containing a student’s work, a portfolio should include the student’s reflections about that work. Portfolios help students establish ownership and direction of their own learning.

Rating scale – A rating scale lists criteria or characteristics to be related and then uses simple descriptors or numeric values to indicate the degree (or frequency) with which the characteristic is present. For instance, a teacher might rate the level of a student’s participation in group activities on a continuum from “never” to “always.”

Rubric – A rubric is a scoring scale that specifies the criteria on which a student’s performance will be assessed and describes levels of performance for those criteria. A generic rubric lists general descriptors of level of achievement. A task-specific rubric lists the more precise criteria for a specific performance task. Rubrics are used as one of several assessment tools that teachers need to use. It is best used when students are working on complex tasks such as investigations, performance tasks, projects, or major assignments.

Assessment Issues in Ontario Grade 11 Mathematics

Assessing Expectations

Assessment should be used to determine a student's levels of achievement of Curriculum Expectations. Assessment, therefore, must be linked to the grade 11 Curriculum Expectations.

How *Nelson Mathematics 11* Helps

All of the Curriculum Expectations for Principles of Mathematics, Grade 11, Academic are addressed in the *Nelson Mathematics 11* textbook, and suggestions for their assessment are found in the *Teacher Resource*. The *Teacher Resource* identifies the Curriculum Expectations addressed by each chapter, section, *Challenge*, *Chapter Problem*, and *Performance Task*.

Connecting to the Achievement Chart

A key aspect of the assessment process is developing “task-specific” descriptors or indicators that reflect the standards of achievement of Curriculum Expectations. The Achievement Chart in the curriculum document outlines the provincial standards of achievement. The descriptors for each category and level help teachers design assessment rubrics and scoring scales for specific situations. They also provide a guideline for the teacher to determine whether a student's performance meets the provincial Expectations. The Achievement Chart, as well as some task-specific assessment rubrics and scoring scales, should be shared with students so that they know how they are being assessed. In some cases teachers may choose to develop rubrics with students for a specific task.

The Achievement Chart is divided into four categories: Knowledge/Understanding, Thinking/Inquiry/Problem Solving, Communication, and Application. Students are expected to do more than acquire knowledge. They are also expected to solve problems, justify their reasoning, communicate mathematically, and apply their knowledge in different situations. These abilities must all be assessed.

A brief description of each of the categories of the Achievement Chart follows:

Knowledge/Understanding

- performance of an algorithm by hand, mentally, or using technology
- demonstration of understanding of a concept

Thinking/Inquiry/Problem Solving

- formulation and defense of hypothesis/conjecture
- creation of a model (algebraic, graphical, geometric, physical, technological) to solve a problem
- selection and sequencing of a variety of tools and strategies to solve a problem
- justification of reasoning and/or conclusion

Communication

- clarity of explanations and justifications
- appropriate use of mathematical vocabulary
- correct use of mathematical symbols, labels, and conventions
- ability to read and interpret mathematics
- ability to integrate narrative and mathematical forms of communication

Application

- selection and appropriate use of a tool to solve a problem
- use of a strategy in an unfamiliar (from slightly to very) setting
- application of a strategy or tool to a complex setting or in a different way (such as students creating a question)

How *Nelson Mathematics 11* Helps with the Assessment of Achievement of Curriculum Expectations

- In every *Practise, Apply, Solve* section in the text, a question is identified for each category of the Achievement Chart.
- Generic Rubrics for each of the four categories of the Achievement Chart are supplied at the end of the Assessment Section to assist teachers with building their own task-specific rubrics.
- Specific rubrics for the *Challenges* and *Performance Tasks* are provided at the end of the relevant sections in the *Teacher Resource*. These rubrics are based on the generic rubrics.
- A rubric for use with all the *Chapter Problems* is provided on page A-16.

Assessing Learning Skills

The Learning Skills do not form part of the student's achievement mark but are reported separately on the report card. The Learning Skills include:

Work Habits

- use of class time and study time
- completeness of homework and assignments
- taking time to produce quality work

Organization

- notebook organization
- time management - use of a planner
- preparation for class
- organization of work submitted

Independence

- commitment to completing a task
- responsibility for own learning

Teamwork

- respect for other people and their opinions
- involvement in group work - share the workload
- cooperation and encouragement in group work

Initiative

- interest and curiosity in new learning situations
- self-directed (if absent, finds out what was missed and comes in for extra help when necessary)
- willing to take risks to promote learning

The importance of assessing Learning Skills is to help students develop these skills. There are many ways to assess Learning Skills. A teacher may assess Learning Skills by monitoring homework or time management on an assigned task. Often Learning Skills such as Teamwork and Organization can be assessed (along with Curriculum Expectations) during work on a group assessment task. The assessment of Independence and Initiative can be carried out using a combination of teacher and self-assessment strategies. A Learning Skills Portfolio is another way of assessing Learning Skills and for encouraging students to take ownership of developing these skills.

How *Nelson Mathematics 11* Helps with the Assessment of Learning Skills

- Opportunities for assessing Learning Skills within each chapter are suggested in the *Teacher Resource*.
- Generic Rubrics for assessing Learning Skills are provided as blackline masters on page A–30. Teachers will find these rubrics useful in assessing Learning Skills. For instance, parts of the *Generic Rubric for Teamwork* could be incorporated into a rubric for assessing a group Performance Task. The Generic Rubric for Initiative could be incorporated into a self-assessment sheet. Parts of these generic rubrics could also be used as assessment tools while the teacher is circulating and observing students at work.
- Strategies and tools for assessing Learning Skills are described in this section of the *Teacher Resource*.
- Sample Learning Skills self-assessment tools are provided as blackline masters at the end of the Assessment and Evaluation Section beginning on page A–22. These self-assessment tools could be incorporated into a Learning Skills Portfolio or used on their own. Some of the reflection sheets could be completed in class after a major assessment is returned to students while others, such as the one on Initiative, could be completed when the student feels he/she has demonstrated Initiative.

The Provincial Report Card

Student achievement is formally communicated to students and parents with the Ontario Provincial Report Card, Grades 9-12. The report card provides a record of the student's achievement of Curriculum Expectations in the form of a percentage grade for each course. The report card also includes teacher comments and an evaluation of the student's Learning Skills in each course.

The final grade for each course is determined as follows:

- 70% of the grade is based on assessments and evaluations conducted throughout the course, reflecting a balanced assessment program. The assessment methods used could include tests, quizzes, performance tasks, presentations, portfolios, journals, projects, assignments, etc.
- 30% of the grade is based on a final evaluation in the form of an examination, performance assessment, essay, or any other method suitable to the course content and administered near the end of the course. The final evaluation may also be a combination of several of these forms.

A student's final grade should reflect his or her most consistent level of achievement as opposed to an average of all marks received.

Developing a Balanced Assessment Program

Students should have numerous and varied opportunities to demonstrate the full range of their achievement of the Curriculum Expectations across all four categories of the Achievement Chart.

Teachers can use many strategies and assessment tools to assess achievement of Curriculum Expectations and Learning Skills, including checklists, scoring guides, marking schemes, and rubrics. Rubrics are best used for assessing student work that has several dimensions and can demonstrate various levels of achievement such as problem solving, communication of mathematics solutions, performance tasks, and open-ended questions. Rubrics are not necessary for assessments such as tests that focus primarily on knowledge. a marking scheme or scoring guide is often more suitable for tests.

The following charts will help you select appropriate tasks and scoring methods for a specific assessment purpose.

Assessment Using the Achievement Chart Categories

Category	Assessment Strategy	Assessment Tool
To assess:	You could use:	And score the work with a:
Knowledge and Understanding: performance of an algorithm or understanding of a concept	• a test • a game • teacher questioning • an interview or conference • observation • a focused assignment • homework collection • a portfolio	• skills checklist • anecdotal record • knowledge checklist • group-, peer-, or self-assessment • rating scale • holistic scale • a portfolio • analytical scale • rubric
Problem Solving and Inquiry: applying the steps of the inquiry process	• a case study, assignment, project, math fair • Chapter Challenge • Chapter Problem • Performance Task • investigation • teacher questioning • an assigned independent study • a problem-solving journal or portfolio • observation while thinking aloud or conferencing • a mind map or concept web • development of approaches to a problem • written or oral problem analysis	• rubric • anecdotal record • problem-solving checklist • group-, peer-, or self-assessment • rating scale • negotiated set of criteria
Application: selection and appropriate use of tools or strategy	• performance task • assignment or project • test or quiz • group problem solving • teacher questioning • creation of sample problems • peer tutoring of presentations	• rubric • scoring guide or marking scheme • checklist • rating scale
Communication: the clarity of the explanations; use of mathematical vocabulary, symbols and conventions; ability to read and interpret mathematics; and integrate narrative and mathematics	• teacher questioning • creation of alternative representations • creation of review notes or summaries • an interview or conference • a mind map or concept web • a journal • a written report • observation • peer tutoring and coaching • a portfolio • a presentation, seminar, or debate • a performance task report	• rubric • anecdotal record • group-, peer-, or self-assessment • rating scale • holistic scale • analytical scale

Assessment of Learning Skills

Category	Assessment Strategy	Assessment Tool
To assess:	You could use:	And score the work with a:
Work Habits: the amount of work a student has completed	• a homework check • a notebook check • a work log • a portfolio • student reflection	• checklist • rating scale • rubric
Teamwork: a student's teamwork skills	• a group assignment or worksheet • brainstorming • a group performance task or investigation • a group presentation • a group test • a discussion, debate, or seminar • observation	• anecdotal record • group process checklist • group progress report • performance checklist • collaborative skills checklist • group-, peer-, or self-assessment • rating scale • rubric • negotiated set of criteria
Independence: the ability of a student to work and learn independently	• independent study • assignment, project, or investigation • journal • portfolio • report, seminar, or presentation on an extension topic • independent research project • work log • test • an interview or conference	• anecdotal record • process checklist • progress checklist with milestones • self-assessment • rating scale • rubric • negotiated set of criteria in a learning contract
Initiative: student attitude and responsibility	• observation • self-reporting • journal • work log • questionnaire • an interview or conference	• anecdotal record • group-, peer-, or self-assessment • behaviour checklist • time-on-task profile • rating scale • rubric
Organization: the ability of a student to manage time and projects effectively	• assignment planning calendars • task analysis • work log • project diary or journal • project plan with milestones • peer monitoring • progress conferences	• anecdotal record • group-, peer-, or self-assessment • project completion checklist • rating scale • rubric

Assessment Features in *Nelson Mathematics 11*

Assessment Features in Each Chapter

The following chart summarizes the assessment support in every chapter.

Feature	Purpose and Description	Location
<i>The Chapter Problem</i>	- requires the use of skills and knowledge that correspond to the essential outcomes of the chapter - developed incrementally throughout the chapter - upon completion, provides a model for approaching the case studies - provides formative assessment information as students work through the problem - an ongoing opportunity for consolidation and review of skills, knowledge, and processes	In the student text: - a statement of the Chapter Problem - related questions at the end of relevant sections In the <i>Teacher Resource</i>: - suggestions for preparation, management, and assessment - a blackline master of a generic rubric whose categories match those of the Achievement Chart in the mathematics curriculum (just before the teaching notes for the chapters)
<i>The Challenges</i>	- summative assessment of knowledge, skills, and understanding for the unit - context is similar to problems done in the chapter - address the most important Expectations of the unit	In the student text: - a statement of the Challenge In the <i>Teacher Resource</i>: - performance expectations - solution guidelines - a discussion of the problem and suggestions for assessment, use, and management - a blackline master of a rubric whose categories match those of the Achievement Chart in the mathematics curriculum
<i>Practise, Apply, Solve</i>	- questions and problems that relate to each section in a chapter - may be used as review or extra practice exercises or as a bank of assessment tasks - four questions keyed to the Achievement Chart categories	In the student text: - all of the questions and problems - answers to all questions and problems in the Answers section In the <i>Teacher Resource</i>: - for the four Achievement Chart category questions: - connection to the Achievement Chart - management/assessment suggestions - description of possible Level 3 performance
<i>Extension and Enrichment Activities</i>	allow students to extend their understanding of the chapter concepts in a somewhat different context	In the student text: - in the C-section questions In the <i>Teacher Resource</i>: - a discussion of extension activities and suggestions for assessment, use, and management
<i>Chapter Review Test</i>	- represents the level of performance expected of most students after completing the chapter - four questions keyed to the Achievement Chart categories	In the student text: - the test itself - answers to all questions in the Answers section In the <i>Teacher Resource</i>: - blackline masters of additional sample tests including identification of categories, answers, scoring guides, and marking schemes (at the end of the Chapter teaching notes)

Performance Tasks in Nelson Mathematics 11

Four sets of *Performance Tasks* in the textbook give students the opportunity to attempt a rich problem related to the Curriculum Expectations of the preceding unit. The *Performance Tasks* allow students to demonstrate their achievement of the Expectations as related to several of the categories of the Achievement Chart.

Performance Tasks will appear:

Covering	Following	Topics
Chapters 1 & 2	Chapter 2	Patterns of Growth and Financial Applications
Chapters 3 & 4	Chapter 4	Functions
Chapters 5 & 6	Chapter 6	Trigonometry
Chapter 7	Chapter 7	Investigations of Loci and Conics

How to Use the Performance Tasks

The *Performance Tasks* can be used as:

- a summative assessment task.
- an investigation or inquiry toward the end of a unit.
- a group problem solving activity.

Teachers may select one or two *Performance Tasks* for students or they may have students choose a *Performance Task* that interests them. The *Performance Tasks* can be assigned to individual students or groups of students. Often it is helpful to have students begin working in groups to brainstorm and investigate the problem and then move apart to develop their own solutions. You may want to have students come back together for a second group discussion before refining their solutions.

Support for the Performance Tasks

The *Teacher Resource* provides teachers with information for each task including:

- Recommended Time, Materials / Technology, Curriculum Expectations
- Overview
- Description of Task
- Management Suggestions
- Assessment Suggestions (rubric included)
- Extension Suggestions
- Guidelines for Solution

Suggestions for Carrying out the Performance Tasks

Students can be organized to work on a task in many different ways. Some possible scenarios are provided below.

Individual Work

An individual task could be presented to the whole class with clear procedural instructions given. Students could then work individually on the task. This is like a typical testing situation.

Cooperative Group Work

Most of the *Performance Tasks* lend themselves to some form of group work. A cooperative group could be structured so that each student within a group of three or four has a particular assignment task that contributes to the solution of the problem. For instance, one student could investigate the problem using graphing technology, another using dynamic geometry software, and yet another by building physical model. Results would be shared and discussed and then conclusions formulated.

Another way to structure a cooperative group is to assign a role such as recorder, observer, reporter, time keeper, and materials manager to each student. The roles and the teacher's expectations should be outlined before the task is attempted.

Group Work for the Purpose of Collecting and Sharing Data

In this type of group work, students begin the initial stages of the task working together to collect data and/or brainstorm a difficult problem. After sharing data or ideas, students work on the task individually. In the middle of the task, students may regroup to share what they have learned. Then students separate to refine their work or incorporate new ideas into the solution. Each student's work is assessed individually.

Breaking a *Performance Task* into Stages

The teacher can use a *Performance Task* to lead students through the inquiry or problem solving process: exploring, modelling, transforming and manipulating, inferring and concluding, etc. Alternatively, a teacher may want to focus on one of the stages of problem solving. This approach can be used with individual students or groups.

How to Assess the *Performance Tasks*

The *Teacher Support* for each task includes general information about the task, suggested Achievement Chart categories for assessment with an accompanying rubric, suggested Learning Skills to be assessed, and guidelines for the solution of the problem.

As well as assessing the “product” of the *Performance Task*, teachers should also be assessing the process of solving the problem. This includes assessing problem solving skills as well as the Learning Skills such as Communication, Teamwork, and Independence that are involved in solving the problem. The assessment of these processes is best accomplished through teacher observation. While circulating and observing students on the task, the teacher should be asking probing questions such as:

- What is your plan?
- Why did you ...?
- What would happen if ...?
- What is your next step?
- How did you divide the parts of the problem among group members?

The final product is assessed once the students have completed and submitted their work. The rubrics provided for the *Performance Tasks* include criteria for both process and product.

The rubrics for the *Performance Tasks* are based on the generic rubrics for the Achievement Chart categories, and they have been made more task-specific where appropriate. The suggested Learning Skills can be assessed using suitable components from the generic Learning Skills rubrics on page A-20. There are also suggested strategies for assessing Learning Skills with most activities.

Assessment References and Resources

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Shannon, A. (Ed.). 1999. *High School Assessment: Balanced Assessment for the Mathematics Curriculum*. White Plains, NY: Dale Seymour Publications.

(This is a set of four books based on the work of the Berkeley, Harvard, Michigan State, and Shell Centre Projects.)

The Ontario Curriculum Grades 9 and 10: Mathematics, 1999.

The Ontario Curriculum Grades 11 and 12: Mathematics, 2000.

The Ontario Curriculum, Grades 9 and 10: Program Planning and Assessment, 1999.

Guide to the Provincial Report Card, Grades 9-12

Assessment Blackline Masters

The following blackline masters are provided for teacher use within the classroom.

Assessment of Curriculum Expectations Using the Achievement Chart Categories

- Generic Rubric for Knowledge and Understanding
- Generic Rubric for Application
- Generic Rubric for Thinking, Inquiry, and Problem Solving
- Generic Rubric for Communication
- Generic Rubric for Chapter Problems
- Mathematics Problem-Solving Checklist
- Review Problem Evaluation Sheet

Assessment of Learning Skills

- Generic Rubrics for Learning Skills
- Group Participation: Peer-Assessment
- Learning Skills Tracking Sheet
- Work Habits Self-Reflection Sheet
- Teamwork Self-Reflection Sheet
- Initiative Self-Reflection Sheet
- Independence Self-Reflection Sheet
- Learning Skills Self-Evaluation Checklists