

*Public and Catholic District School Board Writing Partnerships*

Mathematics

# Course Profile

## **Mathematics for Everyday Life**

Grade 12  
Workplace Preparation  
MEL4E

• *for teachers by teachers*

This sample course of study was prepared for teachers to use in meeting local classroom needs, as appropriate. This is not a mandated approach to the teaching of the course. It may be used in its entirety, in part, or adapted.

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Course Profiles are professional development materials designed to help teachers implement the new Grade 12 secondary school curriculum. These materials were created by writing partnerships of school boards and subject associations. The development of these resources was funded by the Ontario Ministry of Education. This document reflects the views of the developers and not necessarily those of the Ministry. Permission is given to reproduce these materials for any purpose except profit. Teachers are also encouraged to amend, revise, edit, cut, paste, and otherwise adapt this material for educational purposes.

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## Course Overview

### Mathematics for Everyday Life, MEL4E, Grade 12, Workplace Preparation

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

**Prerequisite:** Mathematics for Everyday Life, Grade 11, Workplace Preparation

## Course Description

This course enables students to broaden their understanding of mathematics as it is applied in important areas of day-to-day living. Students will use statistics in investigating questions of interest and apply principles of probability in familiar situations. They will also investigate accommodation costs and create household budgets; solve problems involving estimation and measurement; and apply concepts of geometry in the creation of designs.

## How the Course Supports the Ontario Catholic School Graduate Expectations

This course encourages the Catholic learner to develop his/her gifts and abilities to promote growth toward personal responsibility in preparation for their role in society. Throughout the course, emphasis should be placed on moral, ethical, and realistic decision-making in an effort to build responsible citizenship. The classroom environment should instill a spirit of cooperation and foster a collaborative sense of community. Students will be expected to acknowledge and respect the opinions of others as they work effectively as interdependent team members.

## Course Notes

This Course Profile encourages the development of the critical thinking skills that are required to analyse choices and make informed decisions. This course provides an opportunity for students to explore the link between mathematics and everyday life. Emphasis is placed on making informed decisions about statistics, household finances, and design principles. The units in this profile have been clustered into three groups: data collection and analysis, household considerations (everyday financing), and measurement and design. In Units 1 and 2, students investigate, analyse and represent information using a variety of graphical forms and apply principles of probability in familiar situations. Units 3 and 4 focus on accommodation costs and living expenses, which are investigated and represented within various household budgets. Units 5 and 6 deal with basic measurement (estimation, area, perimeter, etc.), and the mathematical processes involved in home improvement projects (construction and design). A summative unit provides an opportunity to link each of these themes to practical applications. Assessment and evaluation using a wide variety of strategies will allow students to demonstrate learning. The use of technology, e.g., graphing calculators, spreadsheets, drawing software, dynamic geometry software, throughout the course will assist student learning.

This Course Profile represents the collective effort of Catholic and Public writing teams. The fully developed units are Units 2 and 6. In addition to these two complete “model” units, a less-detailed Unit Overview Chart for each of the remaining units offers a recommended clustering of expectations and provides a starting point from which teachers can plan the course. It is suggested that students be encouraged to develop and maintain a glossary of terms as they proceed through each of the units.

## Successful implementation of this profile will involve:

### Developing Students’ Employability Skills

This course recognizes and supports the student who is preparing to enter the workplace. Employability skills should be fostered by a classroom environment that emphasizes regular and punctual attendance, teamwork, and appropriate communication among teachers and peers. Practical problem solving activities provide the opportunity for students to demonstrate initiative and apply their decision-making skills.

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### **Creating a Positive Learning Environment**

This course recognizes that many students will bring years of math anxiety to the classroom. It is important for teachers to maintain a positive environment that recognizes student success and accommodates student needs.

### **Linking Curriculum Concepts to Practical Applications**

This course provides many opportunities for students to appreciate the relevance of math in their lives. Concrete applications, such as designing rooms, home-improvement projects and budgets, allow students to make this connection.

### **Using Technology as a Tool for Learning**

The use of technology reinforces student understanding and facilitates problem solving by providing a visual connection to concepts. Technology can also provide students access to problems and mathematics that may have otherwise been beyond their skill level. Appropriate technological tools (scientific and graphing calculators, spreadsheets, budgeting software, Internet, etc.) should be incorporated wherever applicable. It is recommended that teachers ensure that the probability simulation application is loaded on all graphing calculators before beginning Unit 2 (see Activity 2.5 for instructions).

### **Units: Titles and Time**

Unit 1	Information Processing	12 hours
* Unit 2	Take a Chance	20 hours
Unit 3	Finding a Place of Your Own	13 hours
Unit 4	Making Ends Meet	16 hours
Unit 5	Measure by Measure	15 hours
* Unit 6	By Design	22 hours
Unit 7	Making Your Mark (Summative)	12 hours

\* These units are fully developed in this Course Profile.

### **Unit Overviews**

#### **Unit 1: Information Processing**

**Time:** 12 hours

#### **Unit Description**

The link between the collection, representation, and interpretation of data is investigated in this unit. Data collection and survey methods are explored by having the students gather information about a topic of interest to them. Since student-generated data is more relevant, this provides a practical context for this unit. While conducting surveys, students must be instructed to accept “no comment” as a valid answer to any question, and to respect that people may choose not to respond at all. Teachers should be sensitive to the personal nature of some students’ experiences and support them in avoiding disclosure and discussion of sensitive issues. Information collected from various surveys may be applicable to Unit 2 where statistics and probability are studied. In addition, students investigate a variety of graphical forms and develop the ability to effectively present their data, with and without the use of technology. Through graphical analysis, students recognize and explain the trends in the data and form valid conclusions. Again, the visual representation of this data may be used in the discussion of statistics in Unit 2. A summative activity might involve the interpretation and representation of given data in both word and graphical form. Students could be required to present their interpretation with the appropriate justification for their choices.

### Unit Overview Chart

Cluster	Learning Expectations	Assessment Categories	Focus
1	SPV.01, SP1.01, SP1.02 CGE2b, CGE2c	Knowledge/Understanding Application	Constructing Graphs
2	SPV.01, SP1.03 CGE3c, CGE5a	Knowledge/Understanding Communication Application	Interpreting Graphs
3	SPV.02, SP2.01, SP2.02 CGE2c, CGE4f, CGE5e	Knowledge/Understanding Application Communication	Data Collection using Surveys
4	SPV.02, SP2.03, SP2.04 CGE3c, CGE5e	Application Communication Thinking/Inquiry/Problem Solving	Interpretation of Surveys
5	SPV.01, SPV.02, SP1.01, SP1.03, SP2.02, SP2.03	Knowledge/Understanding Application Communication Thinking/Inquiry/Problem Solving	Summative: Interpret Given Data in Words and Graphical Form

### Unit 2: Take a Chance

**Time:** 20 hours

#### Unit Description

Since choices are part of everyday life, this unit provides an opportunity for students to investigate the basics of probability as they relate to common events, such as coin tossing, choosing your favourite coloured candy from a bag, playing the lottery, etc. Throughout the unit, the relevance to practical situations is emphasized. Simple probability experiments and simulations provide the opportunity to predict and explore outcomes. The link between the number of trials and statistical validity is emphasized using technology. Students apply critical thinking skills to interpret the results of probability experiments in order to make informed decisions, e.g., How many times must the coin be flipped before the desired result is achieved? The examination of statistics in the media provides an opportunity to link the skills from Unit 1 to the theory from this unit. Discussions about the representation of data create an awareness of how mathematics is involved in many aspects of our lives.

#### Unit Overview Chart

Cluster	Learning Expectations	Assessment Categories	Focus
1	SPV.03, SP3.01, SP3.02 CGE2b, CGE2c, CGE3c, CGE4f, CGE5a	Knowledge/Understanding Communication	Expressions of Probability
2	SPV.04, SP4.01, SP4.02 CGE2a, CGE2e	Communication Thinking/Inquiry/Problem Solving	Discussion of Statistics in the Media
3	SPV.03, SP3.03, SP3.04 CGE3c, CGE4f	Knowledge/Understanding Application Communication	Probability Experiments
4	SPV0.3, SP3.03, SP3.04, SP3.05 CGE3c, CGE4f	Knowledge/Understanding Communication	Probability Simulations

Cluster	Learning Expectations	Assessment Categories	Focus
5	SPV.03, SPV.04, SP3.01, SP3.02, SP4.01, SP4.02	Knowledge/Understanding Application Communication Thinking/Inquiry/Problem Solving	Summative: Analysis of a Marketing Report

### Unit 3: Finding a Place of Your Own

**Time:** 13 hours

#### Unit Description

To create an awareness of the options, students investigate the costs of accommodation in their local community using current resources such as newspapers, Internet, etc. Accommodation alternatives are explored with an emphasis on comparing renting to owning. Students need to focus on the practical aspects of making accommodation decisions, e.g., budget considerations, location, etc. The monthly costs involved in maintaining both types of accommodation are examined. Emphasis should be placed on examining affordable accommodations. The information collected in this unit can be used in Unit 4 to create realistic budgets.

#### Unit Overview Chart

Cluster	Learning Expectations	Assessment Categories	Focus
1	EFV.01, EF1.02, EF1.03 CGE2c	Knowledge/Understanding Communication	Accommodation Alternatives: Rights and Responsibilities
2	EFV.01, EF1.01, EF1.04 CGE5a	Knowledge/Understanding Thinking/Inquiry/Problem Solving	Renting and Maintaining an Apartment
3	EFV.02, EF2.01, EF2.02, EF2.03, EF2.04 CGE2c, CGE4g, CGE5b	Knowledge/Understanding Application Communication Thinking/Inquiry/Problem Solving	Buying and Maintaining a House
4	EFV.01, EFV.02, EF1.01, EF1.04, EF2.02, EF2.03, EF2.04 CGE3c, CGE4f, CGE4g	Knowledge/Understanding Application Communication Thinking/Inquiry/Problem Solving	Summative: Where Will You Live?

### Unit 4: Making Ends Meet

**Time:** 16 hours

#### Unit Description

Key features of household budgets are identified and appropriate budgets are designed for given case studies. Students determine necessary adjustments to these budgets in response to changing incomes, family responsibilities, and long-term goals. Accommodation information obtained in Unit 3 may be used to help create various budgets in this unit. Technology, such as spreadsheets and budgeting software, aids students in investigating and organizing data. In the summative activity, the creation of relevant personal budgets by each student provides a practical application of the theory studied in this unit. These budgets can be based on current part-time jobs or possible future employment and include possible scenarios that must be considered, e.g., a layoff, car repair, etc.

### Unit Overview Chart

Cluster	Learning Expectations	Assessment Categories	Focus
1	EFV.03, EF3.01, EF3.02 CGE2c, CGE3c	Knowledge/Understanding Thinking/Inquiry/Problem Solving	Budget Considerations
2	EFV.03, EF3.03, EF3.04 CGE2b, CGE2c	Application Communication Thinking/Inquiry/Problem Solving	Developing Budgets
3	EFV.03, EF3.05 CGE3c, CGE4b	Application Thinking/Inquiry/Problem Solving	Adapting Budgets
4	EFV.03, EF3.03, EF3.04 CGE3c, CGE4f	Application Thinking/Inquiry/Problem Solving Communication	Creating a Personal Budget

### Unit 5: Measure by Measure

**Time:** 15 hours

#### Unit Description

Since estimation and measurement are two of the most widely used mathematical skills in daily life, it is important for students to become familiar and adept with these skills. A practical application is provided in Unit 6 where students are required to design various household improvements. Using appropriate tools and personal referents, e.g., the width of a finger being approximately 1 cm, students demonstrate a working knowledge of the metric and imperial systems. Emphasis is placed on the ability to estimate and calculate common measurements, such as distance, volume, perimeter, and area of regular and irregular figures. To provide practical contexts for this unit, students estimate and measure various objects and rooms around the school. The Pythagorean theorem is also explored as students solve problems involving measurement and design. Connections to the use of these skills at home and at work should be provided throughout the entire unit. A summative activity could involve the estimation and calculation of how many objects, e.g., basketballs, or people would be required to completely fill a particular room in the school (gymnasium).

#### Unit Overview Chart

Cluster	Learning Expectations	Assessment Categories	Focus
1	AMV.01, AM1.01, AM1.02 CGE2b	Knowledge/Understanding Application	Applying the Metric and Imperial Systems
2	AMV.01, AMV.02 AM1.03, AM1.04, AM1.05, AM2.08 CGE3c, CGE5h	Knowledge/Understanding Application Communication Thinking/Inquiry/Problem Solving	Estimation of Quantities
3	AMV.02, AM2.02, AM2.03 CGE3c, CGE5a	Knowledge/Understanding Application Communication	Perimeter Calculations
4	AMV.02, AM2.02, AM2.03, AM2.04 CGE3c, CGE5a	Knowledge/Understanding Application Communication Thinking/Inquiry/Problem Solving	Area Calculations
5	AMV.02, AM2.01 CGE4f	Knowledge/Understanding Thinking/Inquiry/Problem Solving	Pythagorean Theorem

Cluster	Learning Expectations	Assessment Categories	Focus
6	AMV0.1, AMV.02, AM1.02, AM1.03, AM1.04, AM2.02, AM2.03 CGE3c, CGE4f, CGE5a	Knowledge/Understanding Application Communication Thinking/Inquiry/Problem Solving	How Much Can We Really Put in There?

## Unit 6: By Design

**Time:** 22 hours

### Unit Description

Students apply their understanding of measurement and geometry to two-dimensional and three-dimensional constructions and symmetrical designs. Drawing software is used to create two-dimensional scale drawings and three-dimensional drawings of a room. Spreadsheet software is used to plan and evaluate project costs in a household improvement. Students are provided class time to apply their understanding of scale to the construction of a three-dimensional scale model of an area of personal interest such as a garden or bridge. The geometric properties of tiling designs and logos are investigated using drawing software and concrete materials. Students complete these investigations with the construction of a personal logo and tiling designs. The summative activity provides an opportunity for students to demonstrate their understanding of the decision-making processes involved in planning, designing, and costing a household improvement.

### Unit Overview Chart

Activity	Learning Expectations	Assessment Categories	Focus
1	AMV.02, AM2.09 CGE4f	Knowledge/Understanding Thinking/Inquiry/Problem Solving Communication Application	Design a household improvement.
2	AMV.02, AM2.05, AM2.06 CGE4b	Knowledge/Understanding	Construct scale drawings using technology.
3	AMV.02, AM2.07 CGE5a	Application	Design and build 3-D scale model.
4	AMV.03, AM3.01 CGE4b, CGE5a	Knowledge/Understanding Communication	Analyse symmetrical designs using technology.
5	AMV.03, AM3.02, AM3.03 CGE3c	Knowledge/Understanding Application Communication	Construct a personal logo using technology.
6	AMV.03, AM3.04, AM3.05 CGE4f, CGE5h	Thinking/Inquiry/Problem Solving	Apply tiling principles to the construction of tiling designs with technology.
7	AMV.02, AMV.03, AM2.05, AM2.09, AM3.02, AM3.05 CGE5h	Knowledge/Understanding Communication Thinking/Inquiry/Problem Solving Application	Making design and purchase decisions.

**Note:** 0.75 hours have been allotted for introducing the Transform menu on *Geometers Sketchpad*.

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## Unit 7: Making Your Mark

**Time:** 12 hours

### Unit Description

This profile encourages the development of the critical thinking skills that are required to analyse choices and make informed decisions. The summative activities should address the key expectations that support the development of these skills. Due to the complexity of the task, teachers may consider pairing students. These expectations can be clustered into four categories:

Cluster 1 – addresses the expectations that require students to analyse statistical information in order to make informed choices.

Cluster 2 – is represented by the expectations that engage students in planning and adjusting personal budgets.

Cluster 3 – is represented by expectations that require students to apply their knowledge about perimeter, area, and scale in order to plan and cost home improvement projects.

Cluster 4 – focuses on the decision-making skills that underlie the design process.

In the development of the summative unit, it is suggested that a scenario reflecting local conditions provide the unifying theme for the activities. The following is a suggestion:

*A single female with a young child plans to open a small video business in her community. She decides to survey the population in her area to gather information about the type of videos she should order for her store. In anticipation of her grand opening, she is considering a raffle for door prizes in order to attract customers. She has saved some money and plans to buy a house in the area. In addition to calculating her monthly costs, she must adjust her current household budget to account for the additional expenses of home ownership and the video business. She plans to renovate one of the rooms in her house to provide a separate office space for the business. A two-dimensional drawing of the room should help her decide how to arrange the office furniture. The perimeter and area of the office is required so that she can estimate the cost of flooring and wall coverings. She plans to design a business logo for the video store's stationery in addition to a screen saver for her office computer that features Escher-like tessellations.*

### Unit Overview Chart

Cluster	Learning Expectations	Assessment Categories	Focus
1	SPV.01, SPV.02, SPV.03, SP1.01, SP1.02, SP1.03, SP2.02, SP2.03, SP2.04, SP3.01, SP3.02, SP3.03 CGE2c, CGE4f, CGE5a	Knowledge/Understanding Communication Thinking/Inquiry/Problem Solving	Construct and interpret graphs based on survey data. Apply understanding of probability to experimental results.
2	EFV.02, EFV.03, AMV.02, EF2.01, EF2.04, EF3.03, EF3.04, EF3.05, AM2.09 CGE3c, CGE4b, CGE5h	Application Communication Thinking/Inquiry/Problem Solving	Determine the type of housing available for a given budget. Design and adjust a budget to reflect changes in the family income.
3	AMV.02, AM2.02, AM2.06 CGE2b, CGE5a	Knowledge/Understanding Application Communication	Determine the perimeter and area of a room and create a two-dimensional drawing.
4	AMV0.3, AM3.03, AM3.05 CGE2c, CGE3c	Knowledge/Understanding Application	Design a business logo and computer screen saver.

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## Teaching/Learning Strategies

Students will benefit from multiple experiences with applications that are relevant to their daily lives and will prepare them for the workplace. Large tasks should be sequenced into logical steps and connections to prior learning should be made and reinforced as necessary. A flexible teaching style that recognizes individual strengths, engages students in their learning, and provides frequent and varied feedback will ensure a greater likelihood of student success.

In planning the delivery of this course, teachers should:

- become familiar with exceptional students' IEPs and make appropriate accommodations based on student needs;
- identify and build on student's prior knowledge;
- provide a variety of learning experiences that focus on active learning and draw from the workplace setting;
- use a variety of instructional strategies to address varied learning styles;
- include a balance of whole class, small group, and individual instruction;
- use mini-lessons to introduce skills as necessary;
- provide many and varied opportunities for student success using regular, constructive feedback;
- use positive reinforcement to foster students' confidence in their mathematical abilities;
- provide students with activities that involve developing critical thinking and decision-making skills;
- provide review, remediation, and extension when appropriate;
- integrate technology when appropriate;
- use current and local information to promote relevance.

In achieving the expectations of this course, students will:

- recognize the importance of math in the workplace;
- utilize a variety of resources to solve problems;
- develop practical decision-making and organizational skills;
- use estimation to judge the reasonableness of answers;
- work individually as well as cooperatively;
- increase proficiency with technology as it pertains to the course material;
- become informed consumers;
- investigate and explore concepts using technology;
- create a glossary of terms and add to it on an on-going basis.

## Assessment & Evaluation of Student Achievement

- To effectively assess student achievement, a balance of diagnostic, formative, and summative assessment instruments should be used.
- Seventy per cent of the grade will be based on assessment and evaluations conducted throughout the course.
- Thirty per cent of the grade will be based on a final evaluation in the form of an examination, performance, essay, and/or other methods of evaluation.
- High quality assessments should motivate students to improve their own learning, inform teachers about the effectiveness of instruction, and identify areas for improvement in both teaching and learning.
- In order for assessment and evaluation to be valid, it must reflect the instructional framework of the course. Students must be provided with a variety of ways to demonstrate their understanding and be given opportunities to achieve these expectations throughout the course.
- Parents, students and teachers work together to set future goals for student self-improvement.
- Evaluation of student achievement is based on the criteria provided by the Achievement Chart categories.

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Specific tools, which may be considered, are suggested below. These lists, while not comprehensive, may serve as a guide for assessing and evaluating student achievement. Generic rubrics that can be adapted to specific tasks are provided at the OAME/OMCA website: [www.oame.on.ca](http://www.oame.on.ca). These materials are available under “CARE Package.”

### **Knowledge/Understanding**

Achievement in this category reflects the student’s ability to demonstrate an understanding of mathematical concepts and to perform algorithms.

Assessment/evaluation may include the use of:

- skill-based calculations on assignments, tests, exams;
- student-teacher conferencing;
- accuracy of mathematical answers in reports and presentations.

### **Application**

Achievement in this category reflects the student’s ability to apply concepts and procedures to familiar and unfamiliar settings.

Assessment/evaluation may include the use of:

- problems requiring the selection and application of formulas;
- appropriate application of technological tools.

### **Thinking/Inquiry/Problem Solving**

Achievement in this category reflects the student’s ability to demonstrate reasoning and to apply the steps of the inquiry/problem solving process effectively. This category is especially conducive to the use of rubrics due to the open-ended nature of many of the problems.

Assessment/evaluation may include the use of:

- open-ended questions;
- exploration tasks requiring interpretation of the results;
- observations of problem solving strategies used in group work;
- student-teacher conferencing;
- tasks requiring complexity of mathematical reasoning in reports and presentations.

### **Communication**

Achievement in this category reflects the student’s ability to communicate his/her reasoning using appropriate mathematical language, symbols, and conventions. Rubrics are effective and efficient tools for this type of evaluation.

Assessment/evaluation may include the use of:

- verbal presentation of solutions and homework;
- appropriate use of mathematical language on tests and assignments;
- journals;
- visual aids during presentations;
- reports and assignments;
- student-teacher conferencing.

### **To Assess Learning Skills**

While learning skills are not to be included in the determination of the student’s grade, teachers and students should be aware of the importance that these skills have on the student’s performance. In addition, these skills need to be reported on the report card, and thus need to be tracked throughout the course.

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The following is a partial list of suggested indicators of learning skills:

**Organization**

- preparedness (materials for class)
- work is submitted on time
- notebook

**Work Habits**

- regular completion of homework
- use of class time
- attendance and punctuality

**Team Work**

- cooperation in group settings
- respect for the opinions of others

**Initiative**

- participates in class discussion
- responsibility for own learning, e.g., tutoring

**Works Independently**

- commitment to task
- effort to solving problems individually

**Accommodations**

Appropriate accommodations should be a part of the planning of each unit and reflect the needs of the students in the class. When planning instructional and assessment activities, teachers must consider the students' strengths and needs in light of the learning expectations and accommodations identified in the students' IEPs (whether the students are formally identified or not) (Regulation 181/98).

**Special Considerations for Students**

- Provide flexible timelines with respect to the completion of projects and assignments.
- Allow students to work in alternate settings where students can receive assistance with problems.
- Provide alternate formats for assignments, e.g., demonstration, oral presentation, written report.
- Provide multiple opportunities for success by employing a variety of assessments.
- Allow accommodations with respect to test/exam writing environments, e.g., extra time, use of technology, cueing, etc.

**Accommodations for Students with Learning Disabilities**

- Change the style of presentation.
- Provide access to technology and specialized equipment when appropriate.
- Provide additional time and alternate formats for assessment.
- Include more concrete experiences where appropriate.
- Vary the pace of learning.
- Subdivide tasks.
- Pair students.
- Use easy to read fonts and layouts in handouts with concise instructions.
- Provide models and templates.
- Provide alternate environments in which to complete tests.
- Reinforce instructions on an individual basis.

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### **Accommodations for ESL/ELD Students**

- Use peer tutoring to reinforce instructions and provide models.
- Provide extensive student/teacher conferencing.
- Limit complex sentence structures in oral and written formats.
- Provide visual/auditory clues.
- Use a word wall for subject-specific terminology.
- Partner students with the same linguistic background.
- Combine written instructions with verbal instructions.
- Highlight key words or phrases.
- Provide opportunities to practise oral presentation skills.

### **Resources**

Units in the Course Profile make reference to the use of specific websites. Teachers need to consult their board policies regarding use of any copyrighted materials. Before reproducing materials for student use from printed publications, teachers need to ensure that their board has a Cancopy licence and that this licence covers the resources they wish to use. Before screening videos/films with their students, teachers need to ensure that their board/school has obtained the appropriate public performance videocassette licence from an authorized distributor, e.g., Audio Cine Films Inc. Teachers are reminded that much of the material on the Internet is protected by copyright. The copyright is usually owned by the person or organization that created the work. Reproduction of any work or substantial part of any work on the Internet is not allowed without the permission of the owner.

### **Websites**

The URLs for the websites were verified by the writers prior to publication. Given the frequency with which these designations change, teachers should always verify the websites prior to assigning them for student use.

<http://www.cmhc.ca/banner1/>

<http://www.rona.ca/>

<http://www.nycenet.edu/oit/math-kitecture/index.htm>

<http://mathforum.org/workshops/sum98/participants/sanders/>

[www.scalemodel.net/](http://www.scalemodel.net/)

<http://www.schools.ash.org.au/stkierans-manly/Classes/Yr6/6B/Symmetry/page1.html>

[http://www.gopromos.com/idea\\_center/stock\\_art\\_alpha.asp?type=L](http://www.gopromos.com/idea_center/stock_art_alpha.asp?type=L)

<http://www2.spsu.edu/math/tile/index.htm>

<http://155.187.10.12/flags/flags.html>

[www.style-line.com](http://www.style-line.com)

<http://mathforum.com/geometry/rugs/>

<http://library.thinkquest.org/16661/>

<http://www.izzy.net/~jc/EscherTiles/EscherTiles.html>

<http://www.col-ed.org/cur/math/math48.txt>

<http://www.uiowa.edu/~tutimp/modules/probstat/spinners/makespin.htm>

<http://www.shazam.econ.ubc.ca/flip/>

<http://www.ti.com/calc>

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## **OSS Considerations**

The following list of resources supports many of the Ontario Secondary School Policies as well as the Ontario Catholic Secondary School Graduate Expectations:

### **Ministry of Education Policy and Reference Documents**

- *Choices into Action: Guidance and Career Education Program Policy*
- *Cooperative Education: Policies and Procedures for Ontario Secondary Schools*
- *Individual Education Plans: Standards for Development, Program Planning, and Implementation, 2000*
- *Mathematics, Grades 9-10*
- *Mathematics, Grades 11-12*
- *Ontario Schools Code of Conduct*
- *Ontario Secondary Schools, Grades 9 to 12: Program and Diploma Requirements*
- *Program Planning and Assessment, Grades 9-12*
- *Violence-Free Schools Policy*

The Ministry of Education has also published several resource documents, brochures, and policy/program memoranda in support of its OSS policies. They are available online at the Ministry of Education website, <http://www.edu.gov.on.ca/eng/document/document.html>.

### **Publications Concerning Faith Development**

- *Blueprints* (Catholic Curriculum Cooperative - Central Ontario Region)
- *Catholicity Across The Curriculum* (Ontario Catholic School Trustees' Association)
- *Educating the Soul* (Institute for Catholic Education)
- *Ontario Catholic Secondary School Graduate Expectations* (Institute for Catholic Education)
- *This Moment of Promise* (Ontario Conference of Catholic Bishops)
- *Creating Catholic Curriculum* (Eastern Ontario Catholic Curriculum Cooperative)

### **Career Goals/Cooperative Education Programs**

- *Ontario Youth Apprenticeship Program*
- *Youth Employment Skills Program*

### **Community Partnerships**

Refer to local board policies, e.g., *Relations with Business - Corporate Donations, Sponsorships and Agreements*.

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# Coded Expectations, Mathematics for Everyday Life, Grade 12, Workplace Preparation, MEL4E

## Statistics and Probability

### Overall Expectations

**SPV.01** · construct and interpret graphs;

**SPV.02** · formulate questions, and collect and organize data related to the questions;

**SPV.03** · apply principles of probability to familiar situations;

**SPV.04** · interpret statements about statistics and probability arising from familiar situations and the media.

### Specific Expectations

#### Constructing and Interpreting Graphs

**SP1.01** – represent given data in a variety of graphical forms, using spreadsheets or other suitable graphing technology;

**SP1.02** – select an effective graphical form for a given set of data and explain reasons for the choice;

**SP1.03** – interpret graphs by identifying trends and describing the meaning of the trends within the context of the data.

#### Collecting and Organizing Data

**SP2.01** – identify issues or questions of interest and collect related data, using an appropriate sampling technique;

**SP2.02** – construct tables and graphs to represent collected data, using spreadsheets or other suitable graphing technology;

**SP2.03** – draw appropriate conclusions about questions or issues on the basis of the interpretation of graphs;

**SP2.04** – explain conclusions clearly.

#### Applying Principles of Probability

**SP3.01** – express probabilities of simple events as the number of favourable outcomes divided by the total number of outcomes;

**SP3.02** – express probabilities as fractions, decimals, and percents, and interpret probabilities expressed in each of these forms;

**SP3.03** – describe the results obtained in carrying out probability experiments related to familiar situations involving chance (e.g., rolling dice, spinning spinners, flipping coins);

**SP3.04** – compare predicted and experimental results for familiar situations involving chance, using technology to extend the number of experimental trials (e.g., using a random number generator on a spreadsheet or on a graphing calculator);

**SP3.05** – simulate familiar situations involving chance and explain the choice of simulation (e.g., simulate the gender of children in a family by the repeated flipping of a coin and explain why coin flipping was used).

#### Interpreting Statements About Statistics and Probability

**SP4.01** – interpret information about probabilities to assist in making informed decisions in a variety of situations (e.g., evaluating risk versus reward in the purchase of lottery tickets);

**SP4.02** – interpret and assess statistical and probabilistic information used in the media and in common conversation (e.g., vague statements such as “four out of five dentists recommend”; statements about odds; scales on graphs).

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## Everyday Financing

### Overall Expectations

**EFV.01** · determine the costs involved in renting an apartment;

**EFV.02** · determine the costs involved in buying a house;

**EFV.03** · design household budgets for given circumstances.

### Specific Expectations

#### Determining the Costs of Renting an Apartment

**EF1.01** – determine, through investigation, the costs of apartment rentals in the surrounding community;

**EF1.02** – describe the alternatives available (e.g., leasing, renting month to month) and the procedures involved (e.g., paying a deposit) in renting an apartment;

**EF1.03** – describe the rights and responsibilities of an apartment tenant and an apartment landlord;

**EF1.04** – calculate the monthly costs involved in maintaining an apartment.

#### Determining the Costs of Buying a House

**EF2.01** – determine, through investigation, patterns in the cost of housing in the surrounding community (e.g., what kind of house can be purchased for \$75 000? \$140 000? \$250 000? \$400 000?);

**EF2.02** – describe the procedures and costs involved in purchasing a house;

**EF2.03** – identify the costs involved in maintaining a house;

**EF2.04** – calculate the monthly costs involved in maintaining a given house.

#### Designing Budgets

**EF3.01** – identify typical components (e.g., accommodation, food, savings) and their dispersion in a household budget;

**EF3.02** – determine the type of housing affordable in the surrounding community by a person with a given income and family responsibilities;

**EF3.03** – design an appropriate monthly budget for a person living in the surrounding community who has a given income, family responsibilities, and long-term savings goals;

**EF3.04** – present a budget in a clear fashion, using appropriate mathematical forms (e.g., written or oral explanations, charts, tables, graphs, calculations);

**EF3.05** – investigate the effect on an overall budget of changing one component, using a given spreadsheet template or budgeting software.

## Applications of Measurement and Geometry

### Overall Expectations

**AMV.01** · use measurement and strategies of estimation in a variety of applications;

**AMV.02** · solve problems involving measurement and design;

**AMV.03** · apply transformation geometry in creating effective designs.

### Specific Expectations

#### Measuring and Estimating

**AM1.01** – demonstrate a working knowledge of the metric system;

**AM1.02** – measure lengths accurately, using the metric system and the imperial system;

**AM1.03** – estimate distances in metric units and in imperial units by applying personal referents (e.g., the width of a finger is approximately 1 cm; the length of a piece of standard loose-leaf paper is about 1 foot);

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**AM1.04** – estimate capacities in metric units by applying personal referents (e.g., a can of pop is about 350 mL);

**AM1.05** – estimate, with reasonable accuracy, large numbers that are illustrated visually (e.g., books on a wall in a library, pictures of crowds, populations of high-rise buildings), and explain the strategies used.

### **Solving Problems Involving Measurement and Design**

**AM2.01** – demonstrate an understanding of the Pythagorean theorem, by constructing on a floor a rectangular region having accurate right-angled corners;

**AM2.02** – determine the perimeter and area of regular and irregular figures from given diagrams;

**AM2.03** – estimate, with reasonable accuracy, perimeters and areas of large regions (e.g., a playing field), and explain the strategies used;

**AM2.04** – demonstrate an understanding of the effect on the area of familiar objects (e.g., a photograph, a television screen, a road map) of multiplying each dimension by the same factor;

**AM2.05** – make a two-dimensional scale drawing of a room, using design or drawing software effectively;

**AM2.06** – create a three-dimensional drawing of the interior of a room, using design or drawing software effectively;

**AM2.07** – construct, with reasonable accuracy, a scale model of an environment of personal interest (e.g., a building, a garden, a bridge);

**AM2.08** – estimate and calculate the surface area and volume of objects and containers in the surrounding environment that approximate the shape of rectangular prisms and cylinders;

**AM2.09** – investigate the making of a household improvement (e.g., landscaping a property, decorating a room), design the improvement, and estimate and calculate the cost, using technology (e.g., spreadsheets, design or drawing software).

### **Applying Transformation Geometry**

**AM3.01** – describe the use of translations, reflections, rotations, and dilatations as they relate to symmetry and design in logos, with the aid of technology (e.g., dynamic geometry software, design or drawing software);

**AM3.02** – analyse the geometric aspects of interesting and appealing applications (e.g., logos found in advertising, designs found in fabric or wallpaper);

**AM3.03** – create a personal logo, using the mathematics of symmetry, translations, reflections, rotations, or dilatations, with the aid of technology (e.g., dynamic geometry software, design or drawing software);

**AM3.04** – determine, through investigations, using concrete materials and technology, the characteristics of shapes that will tile the plane;

**AM3.05** – create designs involving tiling patterns (e.g., Escher-type designs, wallpaper or fabric designs), using technology (e.g., dynamic geometry software, design or drawing software).

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## Ontario Catholic School Graduate Expectations

The graduate is expected to be:

### A Discerning Believer Formed in the Catholic Faith Community who

- CGE1a** -illustrates a basic understanding of the **saving story** of our Christian faith;
- CGE1b** -participates in the **sacramental life** of the church and demonstrates an understanding of the centrality of the Eucharist to our Catholic story;
- CGE1c** -actively reflects on **God’s Word** as communicated through the Hebrew and Christian scriptures;
- CGE1d** -develops attitudes and values founded on Catholic **social teaching** and acts to promote social responsibility, human solidarity and the common good;
- CGE1e** -speaks the **language of life**... “recognizing that life is an unearned gift and that a person entrusted with life does not own it but that one is called to protect and cherish it.” (Witnesses to Faith)
- CGE1f** -seeks intimacy with God and celebrates **communion** with God, others and creation through prayer and worship;
- CGE1g** -understands that one’s purpose or **call in life** comes from God and strives to discern and live out this call throughout life’s journey;
- CGE1h** -respects the **faith traditions**, world religions and the life-journeys of **all people of good will**;
- CGE1i** -integrates faith with life;
- CGE1j** -recognizes that “sin, human weakness, conflict and forgiveness are part of the human journey” and that the cross, the ultimate sign of forgiveness is at the heart of **redemption**. (Witnesses to Faith)

### An Effective Communicator who

- CGE2a** -listens actively and critically to understand and learn in light of gospel values;
- CGE2b** -reads, understands and uses written materials effectively;
- CGE2c** -presents information and ideas clearly and honestly and with sensitivity to others;
- CGE2d** -writes and speaks fluently one or both of Canada’s official languages;
- CGE2e** -uses and integrates the Catholic faith tradition, in the critical analysis of the arts, media, technology and information systems to enhance the quality of life.

### A Reflective and Creative Thinker who

- CGE3a** -recognizes there is more grace in our world than sin and that hope is essential in facing all challenges;
- CGE3b** -creates, adapts, evaluates new ideas in light of the common good;
- CGE3c** -thinks reflectively and creatively to evaluate situations and solve problems;
- CGE3d** -makes decisions in light of gospel values with an informed moral conscience;
- CGE3e** -adopts a holistic approach to life by integrating learning from various subject areas and experience;
- CGE3f** -examines, evaluates and applies knowledge of interdependent systems (physical, political, ethical, socio-economic and ecological) for the development of a just and compassionate society.

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**A Self-Directed, Responsible, Life Long Learner** who

- CGE4a** -demonstrates a confident and positive sense of self and respect for the dignity and welfare of others;
- CGE4b** -demonstrates flexibility and adaptability;
- CGE4c** -takes initiative and demonstrates Christian leadership;
- CGE4d** -responds to, manages and constructively influences change in a discerning manner;
- CGE4e** -sets appropriate goals and priorities in school, work and personal life;
- CGE4f** -applies effective communication, decision-making, problem-solving, time and resource management skills;
- CGE4g** -examines and reflects on one's personal values, abilities and aspirations influencing life's choices and opportunities;
- CGE4h** -participates in leisure and fitness activities for a balanced and healthy lifestyle.

**A Collaborative Contributor** who

- CGE5a** -works effectively as an interdependent team member;
- CGE5b** -thinks critically about the meaning and purpose of work;
- CGE5c** -develops one's God-given potential and makes a meaningful contribution to society;
- CGE5d** -finds meaning, dignity, fulfillment and vocation in work which contributes to the common good;
- CGE5e** -respects the rights, responsibilities and contributions of self and others;
- CGE5f** -exercises Christian leadership in the achievement of individual and group goals;
- CGE5g** -achieves excellence, originality, and integrity in one's own work and supports these qualities in the work of others;
- CGE5h** -applies skills for employability, self-employment and entrepreneurship relative to Christian vocation.

**A Caring Family Member** who

- CGE6a** -relates to family members in a loving, compassionate and respectful manner;
- CGE6b** -recognizes human intimacy and sexuality as God given gifts, to be used as the creator intended;
- CGE6c** -values and honours the important role of the family in society;
- CGE6d** -values and nurtures opportunities for family prayer;
- CGE6e** -ministers to the family, school, parish, and wider community through service.

**A Responsible Citizen** who

- CGE7a** -acts morally and legally as a person formed in Catholic traditions;
- CGE7b** -accepts accountability for one's own actions;
- CGE7c** -seeks and grants forgiveness;
- CGE7d** -promotes the sacredness of life;
- CGE7e** -witnesses Catholic social teaching by promoting equality, democracy, and solidarity for a just, peaceful and compassionate society;
- CGE7f** -respects and affirms the diversity and interdependence of the world's peoples and cultures;
- CGE7g** -respects and understands the history, cultural heritage and pluralism of today's contemporary society;
- CGE7h** -exercises the rights and responsibilities of Canadian citizenship;
- CGE7i** -respects the environment and uses resources wisely;
- CGE7j** -contributes to the common good.

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## Unit 2: Take a Chance

**Time:** 20 hours

### Unit Description

Since choices are part of everyday life, this unit provides an opportunity for students to investigate the basics of probability as they relate to common events, such as coin tossing, choosing your favourite coloured candy from a bag, playing the lottery, etc. Throughout the unit, the relevance to practical situations is emphasized. Simple probability experiments and simulations provide the opportunity to predict and explore outcomes. The link between the number of trials and statistical validity is emphasized using technology. Students apply critical thinking skills to interpret the results of probability experiments in order to make informed decisions, e.g., How many times must the coin be flipped before the desired result is achieved. The examination of statistics in the media provides an opportunity to link the skills from Unit 1 to the theory from this unit. Discussions about the representation of data create an awareness of how mathematics is involved in many aspects of our lives.

### Unit Synopsis Chart

Activity	Time	Learning Expectations	Assessment Categories	Tasks
2.1 Candy Calculation	5 hours	SPV.03, SP3.01, SP3.02 CGE2c, CGE3c, CGE4f, CGE5a	Knowledge/Understanding Communication	Explore concepts of probability
2.2 Alphabet Analysis	5 hours	SPV.03, SP3.01, SP3.02 CGE2b, CGE2c	Knowledge/Understanding Communication	Explore probability as it applies to the English language
2.3 Probability and Statistics in the Media	2 hours	SPV.04, SP4.01, SP4.02 CGE2e, CGE4g, CGE5a	Communication	Demonstrate understanding of probability in the media
2.4 Once Again	5 hours	SPV.03, SP3.03, SP3.04 CGE3c, CGE4f	Knowledge/Understanding Communication Thinking/Inquiry/Problem Solving	Perform probability experiments
2.5 Probability Simulation	1.5 hours	SPV.03, SP3.03, SP3.04, SP3.05 CGE3c, CGE4f, CGE5a	Knowledge/Understanding Application Communication	Use technology to extend the number of trials in probability experiments
2.6 Summative Assessment	1.5 hours	SPV.01, SPV.03, SPV.04, SP1.01, SP3.02, SP3.05, SP4.01, SP4.02 CGE3c, CGE4f, CGE5a	Knowledge/Understanding Communication Thinking/Inquiry/Problem Solving	Apply probability knowledge to a given scenario

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## Activity 2.1: Candy Calculations

**Time:** 5 hours

### Description

Students explore the principles of probability as they analyse the composition of a bag of candy. The various ways of expressing probabilities are investigated within the activity and relationships in the data collected are reported graphically. Students interpret the data and communicate the meaning of the probabilities discovered.

### Strand(s) & Learning Expectations

**Strand(s):** Statistics and Probability

#### Ontario Catholic School Graduate Expectations

CGE2c - an effective communicator who presents information and ideas clearly and honestly and with sensitivity to others;

CGE3c - a reflective and creative thinker who thinks reflectively and creatively to evaluate situations and solve problems;

CGE4f - a self-directed, responsible, life long learner who applies effective communication, decision-making, problem-solving, time and resource management skills;

CGE5a - a collaborative contributor who works effectively as an interdependent team member.

#### Overall Expectations

SPV.03 - apply principles of probability to familiar situations.

#### Specific Expectations

SP3.01 - express probabilities of simple events as the number of favourable outcomes divided by the total number of outcomes;

SP3.02 - express probabilities as fractions, decimals, and percents, and interpret probabilities expressed in each of these forms.

#### Prior Knowledge & Skills

- Students should review the construction of bar and pie graphs.
- Students should review the use of tally sheets.

#### Planning Notes

- Show National Film Board (NFB) video called “Of Dice and Men” as an introduction or alternately use dice to present the concepts of favourable outcome, total number of outcomes.
- Bring enough packages of coloured candy to allow one package per group or assign each group to bring a package.
- Ensure that the candy chosen does not compromise any student with food allergies.
- There is a concern about hygiene and the potential to spread germs. The candy should be wrapped. Alternatives would be to use coloured marbles or collect the candy so that none is eaten.
- Arrange students in small groups (maximum four people); perhaps arrange desks into groups to facilitate activity.
- Prepare overheads of worksheets for use in explaining how to complete activity and for sample calculations. Mini-lessons should accompany each worksheet to ensure that students are adequately prepared for the required calculations.
- Provide a class set of graphing calculators for graphical analysis of data, if desired.
- Allow 75 minutes for explanation of activity, sample calculations, and gathering of data.
- Allow 75 minutes for analysis of data and completion of summary letter.
- Allow 75-150 minutes for follow-up activities.

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## Teaching/Learning Strategies

### Teacher Facilitation

- Begin the class with a discussion about how companies decide what colours to use for new cars; how many “hot new toys” to make; how much to charge for an item; etc.
- Link these concepts to the gathering of data (Unit 1) and the idea of probability.
- Stress that a knowledge of probability can be used in a number of work situations (e.g., how many items should be ordered each week; how many orders of fries are likely to be requested during a certain time, etc.).
- As an application, discuss the composition of a bag of coloured candy. Areas to explore might include: (a) estimation of the number of candies in the bag; (b) prediction of how many of each colour will be present; (c) which colours will be most/least popular and why; and (d) whether all bags have the same number of candies.
- Have students record their estimates on the worksheet provided **prior** to completing the activity.
- Arrange the students in small groups (no more than 4 students per group) and distribute worksheets for the activity.
- The teacher may be required to go through sample calculations/mini-lessons on the overhead for each worksheet. Have students complete one worksheet before beginning the next one.
- Continual linking of terms to activity applications will be necessary to ensure student understanding.
- A review of the construction of bar and pie graphs by hand or with the graphing calculators (if programs are available) may be necessary. For question 5 of Worksheet 2, the teacher may choose to lead the class in the construction of the graphs.
- Circulate amongst groups to provide help with calculations as required and to encourage teamwork and the exchange of ideas.
- Between worksheets, discuss and review essential concepts focusing on practical applications of this knowledge, e.g., marketing of candies during certain times of the year.
- For Worksheet 2, use a template (board or overhead) to collect the class data.
- Instruct students that they are **not** to eat any candy until the activity is completed.
- Students can demonstrate their understanding of probability by writing a journal entry explaining what probability means to them.

### Student Activity

Your class has been hired by a consumer research company to conduct a mathematical investigation of a popular brand of candy. With your teacher’s help, complete the calculations outlined in the worksheets provided. Remember – you are not to eat any of the candy until your work is complete!

#### Worksheet 1 – Group Data

1. a) Estimate the number of candies in your package before you open it.  
b) Describe how you arrived at this value.
2. To predict the number of each colour of candy in your package, complete the experiment and record your data in the following chart:
  - Without looking in your package, remove one candy.
  - Record the colour in the chart below and add a mark to the “tallies” column (Column A)
  - Return the candy back to the package and shake gently before drawing again
  - Repeat these steps 30 times.
  - For each colour, add up the tallies, and fill in the result in the Total column (Column B).
  - Add up your total column (Column B) and record the result in the Grand Total section.

<b>Colour</b>	<b>A Tallies</b>	<b>B Total</b>	<b>C Predicted Number</b>	<b>D Actual Number</b>	<b>E Theoretical Probability</b>
Grand Total	30				

Probability can be defined as the number of favourable outcomes/total number of outcomes. Make sure that you write this as a FRACTION. Each candy colour can be thought of as a Favourable Outcome.

- Calculate the probability of finding each colour by dividing the tally total for each colour by the grand total (Column B/Grand Total). Record your probability values (as decimals) in the table above. Show the calculation you used to find your answers.
- Add up the values in Column C. Compare your total with that of other groups. What do you notice?
- Based on your probability calculations:
  - Which colour will be present most in your package? Predict its probability.
  - Which colour will be present least in your package? Predict its probability.
- Count all of the candies in your package (do not eat any!):
  - How many candies are in your package?
  - How does this value compare with the value you estimated in Step 1?
- For each candy colour, multiply the probability value for that colour by the total number of candies in the package and record the values in the Predicted Number column of the chart.
- Remove the candies from the package and count the number of each colour. Record these values in the Actual Number column (Column D) of the chart.
  - How do the actual values compare with the predicted values? Explain why there may be any differences.
  - Which colour actually occurred most often? Which occurred least often? How do these values compare with your answers in Step 4?
- You can now calculate the theoretical probability of finding each colour by dividing the actual number of each colour (Column D) by the total number of candies in the package. Record these values in the Theoretical Probability column (Column E) of the chart. How do the actual probability values compare to the probability values obtained from your experimental data (Column C)? Explain any differences.

### Worksheet 2 – Class Data

- Record your group's data on the chart (board or overhead) provided by the teacher.
- Combine the data from all groups to form a class set of information (your teacher will help you organize this information). Record the class data in the chart below:

<b>Colour</b>	<b>A Actual Number (total of all groups)</b>	<b>B Probability as a Fraction</b>	<b>C Probability as a Decimal</b>	<b>D Probability as a Percent</b>
Class Aggregate				

3. Probability values can be expressed in several ways. Calculate the probability values for each colour as:
  - A *fraction* by expressing the actual number/grand total. Remember to record your answer in lowest terms in Column B
  - A *decimal* by dividing the numerator of your fraction by the denominator. Record your answers in Column C.
  - A *percent* by multiplying your decimal value by 100. Record your answers in Column D.
4. How does the class data differ from your group's data? Give some reasons for any differences.
5. Explain how you would use this data to predict the number of each colour you would expect to find in a package that is:
  - a. twice the size of your package
  - b. three times the size
  - c. half the size
6. Using the class information.
  - a) Construct bar and pie graphs to illustrate the data.
  - b) Explain the graphs constructed to the other members of your group.
  - c) Which type of graph do you think is most effective for displaying this data? Why?

### Worksheet 3 – Favourite Colours

1. Conduct a survey of the students in your class to determine its favourite colour of candy. Record the results in the table below:

Colour	Number of Students	Percent of Class
Total		

**Note:** to calculate the “percent of class,” divide the number of students by the total and then multiply by 100.

2. (a) Which candy colour is the favourite amongst students in your class?  
(b) Which is the least popular colour?
3. (a) How does the “favourite” colour compare to the colour that occurred most in the class data from Worksheet 2?  
(b) How does the least popular colour compare to the colour that occurred least in Worksheet 2?

**Follow-up Activity:** The teacher could supplement the skills addressed in this activity with textbook exercises on: calculating, expressing (as fractions, decimals and percents), and interpreting the meaning of probability values.

### Assessment & Evaluation of Student Achievement

- Knowledge/Understanding can be formatively assessed by examining individual worksheets. The students' ability to calculate probability accurately and to express probability in its various forms should be the basis of assessment.
- Communication can be assessed, using the Written Report Rubric (see Appendix B), with a journal entry on What does probability mean to you? The teacher can provide feedback on communication skills through student explanations of the graphs constructed in Worksheet 2 to fellow group members.

### Learning Skills

- Organization, initiative, work habits, teamwork, and independence could be assessed throughout the activity by teacher observation, as well as peer assessments.

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## Activity 2.2: Alphabet Analysis

**Time:** 5 hours

### Description

Students explore probability as it applies to the use of letters in the English language. Students determine, through a word game activity and through an analysis of written text, whether some letters of the alphabet are used more often than others.

### Strand(s) & Learning Expectations

#### Ontario Catholic School Graduate Expectations

CGE2b - an effective communicator who reads, understands, and uses written materials effectively;

CGE2c - an effective communicator who presents information and ideas clearly and honestly and with sensitivity to others.

**Strand(s):** Statistics and Probability

#### Overall Expectations

SPV.03 - apply principles of probability to familiar situations.

#### Specific Expectations

SP3.01 - express probabilities of simple events as the number of favourable outcomes divided by the total number of outcomes;

SP3.02 - express probabilities as fractions, decimals, and percents, and interpret probabilities expressed in each of these forms.

### Prior Knowledge & Skills

- Students must know how to calculate probabilities.

### Planning Notes

- Bring enough magazines/newspapers (or pages of text) to class to allow for one per student.
- Prepare two overheads of the letter tracking worksheet to allow for analysis of class data in the Hangman game and in the magazine activity.
- Photocopy letter-tracking worksheets (Activity 1: Letter Tally Worksheet and Class Data – Letter Tally Worksheet; Activity 2: Name Tally Worksheet).
- Find a board game with letter tiles for the letter/point analysis.

### Teaching/Learning Strategies

#### Teacher Facilitation

- Begin the class with a discussion of the English language: How many letters are in our alphabet? How many are vowels? Consonants? Predict which letters are used most/least often.
- Stress the importance of literacy, reading, and communication in the workplace (placing orders, sales, etc.).
- Since some word games may be unfamiliar to some students, teachers may want to have examples of these available.
- Play five or six (or more) rounds of Hangman with the class (at the board or on the overhead) – do not erase the results of the games. With the class, tally the letters used in the Hangman games. To facilitate this process, use an overhead of the letter tracking worksheet. Calculate the probability of using each letter by using the probability formula  $[\# \text{ of successful outcomes} (\# \text{ of times each letter is used in all games}) / \text{total outcomes} (\text{total } \# \text{ of letters used in all games})]$ . This will serve as a quick review of probability calculations prior to beginning the student activity. Compare the results to the predictions made by the students in the earlier class discussion.

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- Distribute a magazine (or newspaper) and a Letter Tracking Worksheet to each student in the class. Students are to choose a page at random and tally the occurrence of letters on the letter tracking worksheet. Instruct students not to jump around the page, but to begin at the first word on the page and proceed systematically through the page until they have tracked at least 200 letters (more is better for validity of calculations). If newspapers/magazines are not available, students could use their math textbooks as print resources for this activity. Alternately, the teacher may choose to distribute a common sample of text to each student to reduce the anxiety associated with tallying a full page. Once the tally is complete, students are to calculate the required probabilities on the worksheet and answer the corresponding questions. At this stage, the teacher may wish to circulate around the room to monitor the accuracy of calculations.
  - Following the activity, the teacher should help students to compile a class set of data on the overhead (total the tallies from each student and arrive at a class total). Students should copy this class data on their Class Data Letter Tracking Worksheet. Using the class data, probabilities for each letter may be re-calculated and compared to individual results. Any differences between class data and individual data can then be compared and discussed. The teacher may choose to collect this worksheet for evaluation.
  - As an experiment, to determine if the probabilities calculated from the class data can be generalized to other applications, have the students conduct an analysis of the letters used in the first and last names of students in the class. Have each student print his/her first and last names on the board. Students then independently determine the probability of each letter being found. A comparison of probability values between this activity and the word analysis activity can then be made.
  - Discuss with the students possible uses for the knowledge acquired in this activity, e.g., decoding messages, creating text signs, etc.

### **Student Activity 1**

1. Choose a page at random from the magazine or newspaper given to you by your teacher.
2. Beginning at the top of the page, tally the letters used in the text you have chosen on the letter tracking worksheet. Do not jump around the page, but go through the text from beginning to end in order until you have tallied at least 200 letters.
3. Complete the calculations required on the worksheet and answer the corresponding questions in complete sentences.
4. Once you have completed your individual analysis, the teacher will help you to compile a class set of data. Copy the class data on the letter tracking worksheet and complete the calculations required.
5. Answer the assignment questions in complete sentences.

### **Student Activity 2**

1. Each student in the class prints his/her first and last name on the board.
2. Using your Name Tally Worksheet, record the letter occurrences.
3. Complete the probability calculations required on the worksheet.
4. Answer the corresponding questions in complete sentences.

### **Letter Tracking Worksheet**

Working in pairs, one student calls out the letter and the other records.

Name of magazine/newspaper used in your analysis:

Page number:

1. Beginning at the top of the page, keep a tally of all letters used in the chart below (Column A). You need to have at least 200 letters in total to complete this activity.
2. Total all of your letter tallies and record this value in the chart (Column B).
3. Add up Column B and put this value in the Grand Total box.

4. Probability values can be expressed in several ways. Calculate the probability values for each letter as:
- A *fraction* by expressing the tally/grand total for each letter. Remember to record your answer in lowest terms in Column C.
  - A *decimal* by dividing the numerator of your fraction by the denominator. Record your answers in Column D.
  - A *percent* by multiplying your decimal value by 100. Record your answers in Column E.

Letter	A Tally	B Frequency	C Probability as a Fraction	D Probability as a Decimal	E Probability as a Percent
A					
Z					
Grand Total					

5. (a) List the top 10 letters in your text from highest to lowest probability.  
 (b) How many vowels are in the top 10? Which vowels are they?  
 (c) How many consonants are in the top 10? Which consonants are they?
6. List the 5 least common letters in your text in order of decreasing probability.

#### Class Data - Letter Tally Worksheet

1. Your teacher will help you compile the class data from the text analysis activity. Copy the Tally Total values onto the chart below (Column A).
2. Add up Column A and put this value in the Grand Total box.
3. Probability values can be expressed in several ways. Calculate the probability values for each letter as:

Letter	A Frequency	B Probability as a Fraction	C Probability as a Decimal	D Probability as a Percent
A				
Z				
Grand Total				

4. a) List the top 10 letters in the class data from highest to lowest probability.  
 b) How many vowels are in the top 10? Which vowels are they?  
 c) How many consonants are in the top 10? Which consonants are they?  
 d) Does the class data match your individual results?  
 e) Describe any differences.  
 f) Why do you think these differences might exist?
5. a) List the 5 least common letters in your text in order of decreasing probability.  
 b) Does the class data match your individual results?  
 c) Describe any differences.  
 d) Why do you think these differences might exist?
6. Of all the letters surveyed, what percentage are vowels?
7. a) Try to form 10 different words from the top 5 letters.  
 b) How many words can you form from the 5 least common letters? List them below.

8. If you were to be chosen as a contestant on a game show involving words:
  - a) Which consonants would be most useful to you? Why?
  - b) Which vowels would be most useful to you? Why?
  - c) Which vowel would be the least useful? Why?
9. In the board game with letter tiles, the letters that are hardest to use, i.e., Less common in words, are worth the most points and the letters that are easiest to use (most common in words) are worth the least points.
  - a) Which 3 letters do you think are worth the most points?
  - b) Name a letter which would be worth the least points.
10. Signs that are used by retailers for displays often come with a set of letters that can be used by the employees to create their own messages. If you were in charge of producing these advertising packages, which letters would you include multiple copies of? Give a mathematical reason for your answer.

### Name Tally Worksheet

1. Each student will print his/her first and last name on the board.
2. Keep a tally of all letters used in the chart below.
3. Total all of your letter tallies and record this value in the chart (Column B).
4. Add up Column B and put this value in the Grand Total box.
5. Probability values can be expressed in several ways. Calculate the probability values for each letter as:

Letter	A Tally	B Frequency	C Probability as a Fraction	D Probability as a Decimal	E Probability as a Percent
A					
Z					
Grand Total					

6. List the top 5 letters in the student names from highest to lowest probability.
7. Is it possible to make a word with these letters?
8. List the 5 least common letters in the student names, in order of decreasing probability.
9.
  - a) Do the probability values determined in this exercise correspond to the probabilities calculated from the class data in Activity 1?
  - b) Describe any differences and suggest reasons for these differences.
10.
  - a) Do you think the probabilities would be different if you surveyed another class? Why or why not?
  - b) What factors might influence the probability values obtained?

**Extension:** Students could decode an encrypted passage created by using simple letter replacements and the calculated probabilities. In addition, students could create their own encrypted passages.

### Assessment & Evaluation of Student Achievement

- Knowledge/Understanding can be assessed by evaluating one set of probability calculation worksheets (either individual worksheets or class data worksheets). Emphasis should be placed on the ability of students to use the probability formula (successful outcomes / total outcomes) to arrive at their solutions, and to express probabilities in various forms.
- Communication can be assessed in the written responses to the worksheet questions. Emphasis should be placed on the ability of students to use mathematical terminology in the explanations they provide.

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## Accommodations

- Provide an alternative work setting for the letter tally activity for students who are easily distracted or who have difficulty staying on task for an extended period of time

## Resources

McGoldrick, Philip. *A Statistical Study on the Letters of the Alphabet or How to Win on The Wheel of Fortune*. <http://www.col-ed.org/cur/math/math48.txt>

## Activity 2.3: Probability and Statistics in the Media

**Time:** 2 hours

### Description

Through a brainstorming session, students discuss their concepts of probability and statistics in the media. Examples from print sources are used to create a probability display. Statements such as “four out of five dentists recommend” or “50% less fat” are analysed to assist students in their ability to make informed decisions in a variety of situations.

### Strand(s) & Learning Expectations

#### Ontario Catholic School Graduate Expectations

CGE2e - uses and integrates the Catholic faith tradition, in the critical analysis of the arts, media, technology, and information systems to enhance the quality of life;

CGE4g - examines and reflects on one’s personal values, abilities and aspirations influencing life’s choices and opportunities;

GCE5a - works effectively as an interdependent team member.

**Strand(s):** Statistics and Probability

#### Overall Expectations

SPV.04 - interpret statements about statistics and probability arising from familiar situations and the media.

#### Specific Expectations

SP4.01 - interpret information about probabilities to assist in making informed decisions in a variety of situations (e.g., evaluating risk versus reward in the purchase of lottery tickets);

SP4.02 - interpret and assess statistical and probabilistic information used in the media and in common conversation (e.g., vague statements such as “four out of five dentists recommend”; statements about odds; scales on graphs).

### Prior Knowledge & Skills

- Basic concepts of probability.

### Planning Notes

- Collect examples of statistics and probability in the media, e.g., sports statistics, odds of lottery wins, etc., or have students bring in various examples.
- Provide students with materials needed for the probability media display, e.g., construction paper, scissors, glue, etc., which will be used as a visual aid in demonstrating understanding of statistics in the media.
- Provide students with appropriate rubric (see Appendix A or Appendix B).
- Provide copies of the worksheet.

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## Teaching/Learning Strategies

### Teacher Facilitation

#### For Student Activity 1: Displaying Probability in the Media

- Have students brainstorm a list of examples where statistics and probability appear in the media, e.g., a batting average of 0.350, “four out of five dentists recommend,” etc.
- Post student responses on board/overhead.
- Stress the relationship of these concepts to every day applications.
- Stress the necessity not to “believe everything you hear” and to make decisions based on information and conscience.
- Students should work in pairs or small groups to select appropriate examples for their displays.
- Students should be reminded that they will have to justify/explain their choices either orally or in a written report (rubric assessment – Appendix A or Appendix B).

#### For Student Activity 2: Analysing Statistics and Probability in the Media

- Lead students through the first example to model the expected approach and interpretation. Possible answers for the “potato chip” scenario may include:
  - 1) chips are “healthier” and have less fat than others
  - 2) “50% less fat than what?” (other potato chip brands), “What was the original amount of fat?”, “What about other ingredients?”, “Are other ingredients substituted for the fat to make them taste better?”
  - 3) “50% less fat than the original chips without unhealthy substitutes”Teachers can modify the suggested scenarios, to suit specific local interests, e.g., use other sports, foods examples, etc.

#### Student Activity 1: Displaying Probability in the Media

1. Construct a media probability display by choosing 10 examples of statistics and/or probability from print media.
2. Choose two examples and provide brief summaries of the meaning of the statements.

#### Student Activity 2

##### Analysing Statistics and Probability in the Media – Worksheet

Scenario	A new potato chip claims to have 50% less fat.	Four out of five dentists recommend White Bright Toothpaste.	The best player on the team has a batting average 0.350.	A local lottery claims that you have a one in 12 chance of winning.
(1) What does this mean to you?				
(2) What additional questions should you ask before making a decision about these claims?				
(3) How could you rewrite the claim to make it more informative?				

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## Assessment & Evaluation of Student Achievement

- Assess both student activities using the appropriate rubric (see Appendix A and Appendix B). Emphasis should be placed on the student's ability to analyse and interpret media statements using mathematical terminology to express their reasoning.

### Activity 2.4: Once Again

**Time:** 5 hours

#### Description

As seen from Activity 2.3 phrases such as, “There is a 20% chance of rain today,” or “What is our team’s chance of winning today?” are common in a student’s world of experience. The media is constantly using predictors and students should be aware of how these numbers are determined. The use of probability experiments is an important step in understanding these predictions. In this activity students perform various familiar experiments and describe their results.

#### Strand(s) & Learning Expectations

##### Ontario Catholic School Graduate Expectations

CGE3c - a reflective and creative thinker who thinks reflectively and creating to evaluate situations and solve problems;

CGE4f - a self-directed, responsible, life long learner who applies effective communication, decision-making, problem-solving, time, and resources management skills.

**Strand(s):** Statistics and Probability

##### Overall Expectations

SPV.03 - apply principles of probability to familiar situation.

##### Specific Expectations

SP3.03 - describe the results obtained in carrying out probability experiments related to familiar situations involving chance (e.g., rolling dice, spinning spinners, flipping coins);

SP3.04 - compare predicted and experimental results for familiar situations involving chance, using technology to extend the number of experimental trials (e.g., using a random number generator on a spreadsheet or on a graphing calculator).

#### Prior Knowledge & Skills

- Students must know how to calculate probabilities.

#### Planning Notes

- Rearrange the classroom into seven stations.
- Obtain required materials: polystyrene cups; metre sticks; dice, spinners; decks of cards.
- Teachers may choose to have students complete associated questions before proceeding to the next station or collect all experimental data first and then complete the questions at the end of the activity
- For Station 4 (Spin the Wheel): use [www.uiowa.edu/~tutimp/modules/probstat/spinners/makespin.htm](http://www.uiowa.edu/~tutimp/modules/probstat/spinners/makespin.htm) to make your own spinner; or find one from a game board.
- For Station 6 (Solve the Mystery): the mystery bags could consist of four different types of candies or one type which has different flavours or colours. Ensure that the candy chosen does not compromise any student with food allergies. **Note:** There is a concern about hygiene and the potential to spread germs. The candy should be wrapped. Alternatives would be to use coloured marbles or collect the candy so that none is eaten.

- For Station 7 (Win a Prize): the game board consists of a number of squares, e.g.,  $20 \times 20$  which are to be twice the width of the chosen coin.
- Prepare overheads of worksheets for use in explaining how to complete the activity.

## Teaching/Learning Strategies

### Teacher Facilitation

- Review probability calculations.
- Demonstrate each probability experiment to ensure student understanding of the required task.
- Provide separate worksheets for each station.
- Have students work in pairs alternating roles (experimenter and recorder) at each station.
- Encourage timely completion of each station.
- Circulate and help groups having difficulties and make sure all groups have complete data.
- Upon completion of activities, allot time for class discussion of each station and the comparison of experimental and actual probabilities.

**Extension:** For Station 3, the teacher may wish to use the website [//shazam.econ.ubc.ca/flip/](http://shazam.econ.ubc.ca/flip/) to extend the number of trials for flipping a coin. This website allows users to participate in an on-going coin-tossing experiment, and demonstrates that the probability of heads versus tails approaches 50/50.

- Teachers may wish to extend the discussion with respect to the consequences of biasing the outcomes, e.g., loaded dice, carnival games.
- To assess application skills, have students design their own probability experiment with appropriate worksheets. A class presentation of these experiments could be used to assess communication skills.

### Student Activity

- Students work in pairs and complete all seven probability activities.
- Students alternate roles (experimenter and recorder) at each station.
- Students record data accurately on provided worksheets and use to answer the related questions.

**Follow-up Activity:** The teacher should supplement the skills in this activity with textbook exercises on predicting outcomes and calculating probabilities of various events.

### Station 1: In the Right Direction

Predict how many times the cup will land right side up.

With the polystyrene cup always facing down, drop it fifty times from a height of one metre. Record your results in the table.

OUTCOME	TALLY	TOTAL
Right-side Up		
Side-ways		
Up-side Down		

### Questions

1. The probability of the cup landing right side up is \_\_\_\_\_.
2. The probability of the cup landing on its side is \_\_\_\_\_.
3. The probability of the cup landing upside down is \_\_\_\_\_.

### Station 2: Roll the Dice

Important: Remember to add the numbers on the two dice.

1. Predict the number of times the total on a pair of dice will be seven, if you were to roll them 50 times.

2. Roll the dice 50 times and keep a record of your results in the appropriate row of the tally column.

SUM of the Dice	TALLY	TOTAL
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		

**Questions**

1. What is the probability of rolling a seven with two dice? How close was your prediction?

**Station 3: Heads or Tails**

- Predict how many heads will occur in 50 flips of a coin.
- Flip a coin and let it land on the floor or desk.
- Record your results in the table.
- Repeat these steps 49 times.

Trials	Heads	Tails	Trials	Heads	Tails
1			26		
....			....		
25			50		

**Questions**

- The probability of getting heads is \_\_\_\_\_.
- The probability of getting tails is \_\_\_\_\_.

**Station 4: Spin the Wheel**

Predict the number of times you will land on blue.

Spin a spinner 50 times and record your results.

Colour	Tally	Total
Red		
Yellow		
Blue		
Green		

**Questions**

- Is the outcome of spinning the colour red as likely as getting green?
- The probability of spinning the colour blue is \_\_\_\_\_.
- The probability of spinning the colour yellow is \_\_\_\_\_.
- The probability of NOT getting red is \_\_\_\_\_.
- The probability of spinning either blue or green is \_\_\_\_\_.

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**Station 5: Cut the Cards**

1. Predict the probability of drawing a diamond.
2. Using a deck of playing cards, shuffle the deck and draw a card.
3. Record the results in the chart.
4. Replace the card in the deck.
5. Repeat these steps 49 times (make sure you shuffle the deck each time).

Outcome	Tally	Total
Black		
Diamond		
Queen of Hearts		

**Questions**

1. Find the following experiential probabilities and explain what you think they should be theoretically?
  - a) drawing a black card
  - b) drawing a diamond
  - c) drawing the queen of hearts

**Station 6: Solve the Mystery**

1. Draw an object from the mystery bag and record the results in the chart.
2. Put the item back into the bag.
3. Repeat these steps 49 more times.
4. Predict what is in the bag

Object	Tally	Total

5. Empty the mystery bag and count the number of items in the bag: \_\_\_\_\_

**Questions**

1. Find the theoretical probability of choosing the object you like the most.
2. Find the probability of choosing the object you like the least.

**Station 7: Win a prize**

Welcome to the Canada Day Carnival! Toss a coin directly into a square to win. Don't let it touch a single line or you lose. Predict the probability of winning this game. Try your luck 50 times and record your results in the chart.

Outcome	Tally	Total
Wins		
Losses		

**Questions**

1. If this was a game at the local fair, would you play? Explain.
2. What is the probability of winning the game?
3. How would the probability change if the squares were larger, the coin was larger, or if there were more squares?

**Assessment & Evaluation of Student Achievement**

- Knowledge/Understanding can be assessed by evaluating individual worksheets. Emphasis should be placed on the ability to calculate and interpret probabilities. The teacher may wish to use one of the stations as an assessment activity and thus reduce the number of stations.

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- Thinking/Inquiry/Problem Solving can be assessed by evaluating the students' predictions and their explanations.
  - Communication can be assessed using a journal entry which explains how to calculate various probabilities.

**Extension:** Students could design their own probability experiments, including the appropriate worksheet and questions. Students could present their probability experiments to the class.

## Resources

[www.uiowa.edu/~tutimp/modules/probstat/spinners/makespin.htm//shazam.econ.ubc.ca/flip/](http://www.uiowa.edu/~tutimp/modules/probstat/spinners/makespin.htm//shazam.econ.ubc.ca/flip/)  
(for sample spinners)

## Activity 2.5: Probability Simulation

**Time:** 1.5 hours

### Description

Students use the probability simulation application on graphing calculators or alternate method to investigate familiar probability experiments and to extend the number of trials for greater validity of results.

### Strand(s) & Learning Expectations

#### Ontario Catholic School Graduate Expectations

CGE3c - thinks reflectively and creatively to evaluate situations and solve problems;

CGE4f - applies effective communication, decision-making, problem-solving, time and resource management skills;

CGE5a - works effectively as an interdependent team member.

**Strand(s):** Statistics and Probability

#### Overall Expectations

SPV.03 - apply principles of probability to familiar situations.

#### Specific Expectations

SP3.03 - describe the results obtained in carrying out probability experiments related to familiar situations involving chance (e.g., rolling dice, spinning spinners, flipping coins);

SP3.04 - compare predicted and experimental results for familiar situations involving chance, using technology to extend the number of experimental trials (e.g., using a random number generator on a spreadsheet or on a graphing calculator);

SP3.05 - simulate familiar situations involving chance and explain the choice of simulation.

### Prior Knowledge & Skills

- Students must know how to calculate probabilities.

### Planning notes

- Make copies of Worksheet Activity 2.5.
- Obtain a class set of graphing calculators. If graphing calculators are not available, this activity can be completed using a spreadsheet or other random number generating software (e.g., *Fathom*).
- Obtain probability simulation software for graphing calculator.
- A graph link cable is required and the operating system and probability application software can be downloaded to one calculator and then transmitted to others.

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## Teaching/Learning Strategies

### Teacher Facilitation

- Review probability calculations.
- Discuss how increasing the number of trials affects probabilities and how technology can be used to simulate many trials.
- Stress the link to market surveys, opinion polls, medical tests, etc., e.g., How effective is this new treatment if it was tested on only ten people?
- Discuss how advertisements, “word of mouth,” and consumer surveys influence purchasing choices, especially for new products.
- Review basic features of the graphing calculator.
- Discuss how to interpret frequency graphs.
- Using the overhead projection panel, guide students through the probability simulation worksheet. This activity should be teacher-directed.
- The teacher may wish to extend the activity with respect to biasing outcomes, e.g., unfair dice, weighted coins. Biased outcomes can be set in the program.
- Students should be given the opportunity to experiment with the application independently following the activity.
- For Part E, Win the Lottery, the teacher can use a calculator to generate daily lottery numbers.
- Discuss the following applications of probability: the futility of gambling; the determination of car insurance rates; determining the number of workers required during peak times; determining how long a wait in line will be; etc.

### Student Activity

- Students work in pairs to help each other with the program.
- Students complete the worksheet together with the teacher.
- All data is to be accurately recorded on the worksheet.

### Worksheet Activity 2.5: Probability Simulation

#### Part A – Coin Toss Simulation

1. Predict the probability of getting heads when a coin is tossed 1000 times.
2. Use the coin toss simulation to toss a coin. Draw the frequency graph shown on the calculator (simple bar graph).
3. Choose the +10 button to continue tossing the coin. Draw the frequency graph shown on the calculator.
4. Choose the +50 button to continue tossing until a number near 500 is reached. Draw the frequency graph shown on the calculator.
5. Continue with the coin toss until approximately 1000 trials are completed. Draw the frequency graph shown on the calculator.
6. View your results in table form.
7. The CumH column tells the number of heads that occurred in the experiment and the Toss column gives the total number of tosses. Use this information to calculate the probability of tossing a head.
8. How do these results compare to the predicted values?
9. How does increasing the number of trials affect the results?

#### Part B – Roll Dice Simulation

1. Predict the probability of rolling a ‘4’ on a die when a die is rolled 1000 times.
2. Use the roll dice simulation and roll a die approximately 10 times. Draw the frequency graph shown on the calculator.
3. Continue rolling until approximately 200 trials are completed. Draw the frequency graph shown on the calculator.

- 
4. Continue rolling until approximately 1000 trials are completed. Draw the frequency graph shown on the calculator.
  5. How do these results compare to the predicted values?
  6. How does increasing the number of trials affect the results?

### **Part C – Spin Spinner Simulation**

1. Predict the probability of spinning a '2'.
2. Use the simulation to spin the spinner approximately 25 times. Draw the frequency graph shown on the calculator.
3. Continue spinning until approximately 500 trials are completed. Draw the frequency graph shown on the calculator.
4. Continue spinning until approximately 1000 trials are completed. Draw the frequency graph shown on the calculator.
5. How do these results compare to the predicted values?
6. How does increasing the number of trials affect the results?

### **Part D – Pick Marbles Simulation**

1. Predict the probability of picking marble A.
2. Use the simulation to pick a marble from the bag approximately 50 times. Draw the frequency graph shown on the calculator.
3. Continue picking marbles until approximately 400 trials are completed. Draw the frequency graph shown on the calculator.
4. Continue picking marbles until approximately 1000 trials are completed. Draw the frequency graph shown on the calculator.
5. How do these results compare to the predicted values?
6. How does increasing the number of trials affect the results?

### **Part E – Win the Lottery**

1. Use the Random Number Generator to perform several trials to determine the occurrence of certain numbers between 1–40.
2. Based on these trials, write down six different numbers between 1–40 that you think will win the lottery.
3. Compare your numbers to the teacher's lottery numbers.
4. Survey the class to determine how many students matched 3, 4, 5, or 6 numbers.
5. Write a paragraph explaining whether there is a good or poor probability of winning a lottery. Give mathematical reasons for your answer.

### **Summary Question**

If a sample of 2000 pregnant women was studied, which of the above simulations would you use to predict the number of male or female babies that will be born? Explain why.

### **Assessment & Evaluation of Student Achievement**

- Knowledge/Understanding can be assessed with a quiz linking simple probability to extended trials.
- Application can be assessed by evaluating students' responses to the summary question using the Written Report Rubric (Appendix B) where the criteria has been adapted to the summary question.
- Communication can be assessed in the written responses to the Worksheet questions. Emphasis should be placed on the ability of students to use mathematical terminology to express their reasoning in the explanations they provide.

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## Resources

<http://education.ti.com/product/tech/83p/apps/apps.html>

Download (Free): (1) TI-Graph Link software Version 2.0; (2) TI-83 Plus operating System Software Version 1.12 or later; and (3) Probability simulation Application Software (User's Manual may also be downloaded) from <http://www.ti.com/calc>

## Activity 2.6: Summative Assessment

**Time:** 1.5 hours

### Description

This summative assessment activity allows students to demonstrate their knowledge of the specific expectations of the unit.

### Strand(s) & Learning Expectations

#### Ontario Catholic School Graduate Expectations

CGE3c - thinks reflectively and creatively to evaluate situations and solve problems;

CGE4f - applies effective communication, decision-making, problem-solving, time and resource management skills;

CGE5a - works effectively as an interdependent team member.

**Strand(s):** Statistics and Probability

#### Overall Expectations

SPV.01 - construct and interpret graphs;

SPV.03 - apply principles of probability to familiar situations;

SPV.04 - interpret statements about statistics and probability arising from familiar situations and the media.

#### Specific Expectations

SP1.01 - represent given data in a variety of graphical forms, using spreadsheets, or other suitable graphing technology;

SP3.02 - express probabilities as fractions, decimals, and percents, and interpret probabilities expressed in each of these forms;

SP3.05 - simulate familiar situations involving chance and explain the choice of simulation;

SP4.01 - interpret information about probabilities to a making informed decisions in a variety of situations;

SP4.02 - interpret and assess statistical and probabilistic information used in the media and in common conversation.

### Prior Knowledge & Skills

- Students must have basic knowledge of probability simulation software on graphing calculators.

### Planning Notes

- Make copies of Worksheet Activity 2.6.
- Obtain a class set of graphing calculators containing the probability simulation application (if graphing calculators are not available, an alternate number-generating program may be used such as Fathom).

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## Teaching/Learning Strategies

### Teacher Facilitation

- Review probability calculations.
- Review graphing techniques from Unit 1. Axes for the bar graph in question 2a may need to be provided to the students.
- Review probability simulation program on the graphing calculator (or other number-generating software).
- Review the interpretation of statistics and probability in the media, as well as market surveys.
- Students work independently to complete this summative activity.

### Student Activity

#### Activity 2.6: Summative Assessment Worksheet

##### Part A

Fifty couples from a small town in Ontario were selected at random and asked how many children each had. Here are the results:

0, 1, 2, 1, 0, 3, 2, 1, 1, 2, 1, 0, 0, 1, 5, 0, 4, 2, 0, 1, 0, 2, 3, 2, 3, 1, 0, 1, 5, 3, 2, 1, 0, 2, 1, 0, 1, 0, 2, 1, 3, 2, 0, 1, 2, 1, 0, 3, 1, 2

1. Use these results to complete the following chart.

Number of Children	Tally	Total	Probability in Fraction Form	Probability in Percent Form	Probability in Decimal Form
0					
5					
Total					

2. a) Construct a bar graph to illustrate this relationship.  
b) Using the percent values, construct a circle graph. Show the calculations you used to convert from percent to degree values.
3. a) What percentage of couples have fewer than 2 children?  
b) What percentage of couples have 3 or more children?  
c) What percentage of couples have children?
4. a) Which probability simulation on the graphing calculator would you use to extend the number of families surveyed? Explain your choice.  
b) Carry out this simulation on your graphing calculator for 300 families. Record your results using a frequency table.
5. Could we use the data from the original survey to make similar conclusions about the number of children in other families: i) in the town? ii) in Ontario? and iii) in Canada? Explain your answer in each case.

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**Part B**

6. A local newspaper reports the following:  
“Preliminary results of a recent survey suggest that the proportion of male babies in the area is on the decline as compared to a similar survey from 20 years ago. Three out of ten local scientists point to increased environmental pollution and hormonal additives to food as probable causes of this phenomenon. A survey of shoppers at the local mall indicates that 77% of the population agrees with these findings.”
- What does this information mean to you?
  - What additional information should you have about the scientists before making a decision about their claim?
  - What information should you have regarding the shopper survey, before making a decision about this claim?
  - Do you think that the results of the shopper’s survey would be different if only one gender or one age group was surveyed?
  - Based on your answers to these questions, do you believe the findings are valid?
7. Describe how to determine the probability of encountering a red light on your way to work.

**Assessment & Evaluation of Student Achievement**

- Knowledge/Understanding can be assessed by scoring the Probability calculation worksheet. The students’ ability to calculate probability accurately and to express it in its various forms should be the basis of assessment.
- Communication can be assessed based on student responses to activity questions.
- Thinking/Inquiry/Problem Solving and Application can be assessed in questions 4 and 7 with emphasis placed on the explanation and justification of the answer.

**Appendices**

Appendix A – Oral Presentation Rubric

Appendix B – Written Report Rubric

## Appendix A

### Oral Presentation Rubric

**Note:** This rubric should be adapted to specific presentations by making each criterion specific to the assignment.

Category	Level 1 (50-59%)	Level 2 (60-69%)	Level 3 (70-79%)	Level 4 (80-100%)
<b>Knowledge/Understanding</b> - understanding of concepts  - accuracy in performing algorithms	- demonstrates a limited understanding of concepts  - demonstrates limited accuracy	- demonstrates some understanding of concepts  - demonstrates some accuracy	- demonstrates a considerable understanding of concepts  - demonstrates considerable accuracy	- demonstrates a thorough understanding of concepts  - demonstrates consistent accuracy
<b>Thinking/Inquiry/Problem Solving</b> - logical and organized presentation of argument	- presents arguments with limited logic and organization	- presents arguments with some logic and organization	- presents arguments with considerable logic and organization	- presents arguments with consistent logic and organization
<b>Communication</b> - use of mathematical terms	- demonstrates limited use of appropriate mathematical terminology  - responds effectively to a limited number of class questions	- demonstrates some use of mathematical terminology  - responds effectively to some class questions	- demonstrates regular use of appropriate mathematical terminology  - responds effectively to a considerable number of class questions	- demonstrates consistent use of appropriate mathematical terminology  - responds effectively to almost all class questions
<b>Application</b> - generalization	- demonstrates limited generalization of mathematical relationships	- generalizes some mathematical relationships with prompting	- generalizes most mathematical relationships	- generalizes almost all relationships

(adapted from the Grade 11 Mathematics of Personal Finance Course Profile)

**Note:** A student whose achievement is below Level 1 (50%) has not met the expectations for this assignment or activity.

## Appendix B

### Written Report Rubric

**Note:** This rubric should be adapted to specific reports by making each criterion task specific, e.g., add concepts.

Category	Level 1 (50-59%)	Level 2 (60-69%)	Level 3 (70-79%)	Level 4 (80-100%)
<b>Knowledge/ Understanding</b> - understanding of concepts  - accuracy in performing algorithms  - presentation of data in tables and graphs	- demonstrates limited understanding of concepts  - demonstrates limited accuracy  - presents data in tables and graphs with limited accuracy	- demonstrates some understanding of concepts  - demonstrates some accuracy  - presents data in tables and graphs with some accuracy	- demonstrates considerable understanding of concepts  - demonstrates considerable accuracy  - presents data in tables and graphs with considerable accuracy	- demonstrates a thorough understanding of concepts  - demonstrates consistent accuracy  - presents data in tables and graphs with a high degree of accuracy
<b>Thinking/Inquiry/ Problem Solving</b> - presentation of arguments using logic and organization	- presents arguments with limited logic and organization	- presents arguments with some logic and organization	- presents arguments that are generally logical and organized	- presents arguments with logic and organization
<b>Communication</b> - use of mathematical terms	- makes limited use of appropriate terms	- makes some use of appropriate terms	- makes considerable use of appropriate terms	- makes consistent use of appropriate terms
<b>Application</b> - application of concepts or procedure	- applies concepts or procedures to problems seen in familiar settings in limited ways	- sometimes applies concepts to problems seen in familiar settings	- regularly applies concepts and procedures to problems seen in familiar settings	- consistently applies concepts and procedures to problems seen in familiar and some unfamiliar settings

(adapted from the Grade 11 Mathematics of Personal Finance Course Profile)

**Note:** A student whose achievement is below Level 1 (50%) has not met the expectations for this assignment or activity.

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## Unit 6: By Design

**Time:** 22 hours

### Unit Description

Students apply their understanding of measurement and geometry to two-dimensional and three-dimensional constructions and symmetrical designs. Drawing software is used to create two-dimensional scale drawings and three-dimensional drawings of a room. Spreadsheet software is used to plan and evaluate project costs in a household improvement. Students are provided class time to apply their understanding of scale to the construction of a 3-D scale model of an area of personal interest such as a garden or bridge. The geometric properties of tiling designs and logos are investigated using drawing software and concrete materials. Students complete these investigations with the construction of a personal logo and tiling designs. The summative activity provides an opportunity for students to demonstrate their understanding of the decision-making processes involved in planning, designing, and costing a household improvement.

### Unit Synopsis Chart

Activity/ Time	Learning Expectations	Assessment Categories	Tasks
1 7.5	AMV.02, AM2.09 CGE4f	Knowledge/Understanding Thinking/Inquiry/Problem Solving Communication Application	Design a household improvement.
2 2.5	AMV.02, AM2.05, AM2.06 CGE4b	Knowledge/Understanding	Construct scale drawings using technology.
3 3.75	AMV.02, AM2.07 CGE5A	Application	Design and build 3-D scale models.
4 1.25	AMV.03, AM3.01 CGE4b, CGE5a	Knowledge/Understanding Communication	Analyse symmetrical designs using technology.
5 1.25	AMV.03, AM3.02, AM3.03 CGE3c	Knowledge/Understanding Application Communication	Construct a personal logo using technology.
6 3.75	AMV.03, AM3.04, AM3.05 CGE4f, CGE5h	Thinking/Inquiry/Problem Solving	Apply tiling principles to the construction of tiling designs with technology.
7 1.25	AMV.02, AMV.03, AM2.05, AM2.09, AM3.02, AM3.05 CGE5h	Knowledge/Understanding Communication Thinking/Inquiry/Problem Solving Application	Making design and purchase decisions.

**Note:** 0.75 hours have been allotted for introducing the Transform menu on *Geometer's Sketchpad*.

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## Activity 6.1: Upgrade your Space

**Time:** 7.5 hours

### Description

Students plan and design a household improvement and calculate project costs within a given budget. A field trip to a home improvement centre is included to acquaint student with the variety of decisions that are made regarding product choices, label reading, and pricing when planning a project. In addition, the visit provides an opportunity for students to demonstrate and strengthen workplace skills such as showing initiative to address job-site challenges and organizing their time efficiently.

### Strand(s) & Learning Expectations

#### Ontario Catholic School Graduate Expectations

CGE4f - a self-directed, responsible, life-long learner who applies effective communication, decision-making, problem-solving, time and resource management skills.

**Strand(s):** Applications of Measurement and Geometry

#### Overall Expectations

AMV.02 - solve problems involving measurement and design.

#### Specific Expectations

AM2.09 - investigate the making of a household improvement, design the improvement, and estimate and calculate the cost, using technology.

### Prior Knowledge & Skills

- Calculate perimeter and area using a calculator.
- Measure and read metric and imperial measures; determine an appropriate scale and construct scale drawings using drawing software.
- Calculate costs using unit prices.

### Planning Notes

- Book the computer lab or provide access to classroom computers.
- Provide calculators, pencils, building supply flyers, home renovation magazines and books.
- Bring a home improvement supply such as paint cans for label reading practice to class.
- Prepare sample worksheets.
- Prepare and install the spreadsheet on the computers.
- Make prior arrangements with the home improvement store for a tour on the day of the store visit. Book buses and prepare permission forms as required or prepare a list of on-line catalogues in order to access product availability, pricing, and label information.
- Task 2 must be completed after Activity 2. This provides time to revise the project, take measurements, and learn to draw 2-D scale drawings using technology.

### Teaching/Learning Strategies

#### Teacher Facilitation

Task 1: Project Proposal

- Provide a budget amount, for example, \$250 and record in Sample Worksheet 1.
- Brainstorm project ideas with the students and record them on chart paper. Guide students so that project plans are reasonable in size and depth and within the budget amount. For instance: painting, wallpapering, and adding decorative moulding is reasonable but changing the interior structure of a room or adding an addition is beyond the expectations of this activity.
- Review the 6 tasks and determine due dates and record them on Sample Worksheet 1.

- 
- In preparation for the scale drawings in Task 2, students must measure the floors and walls (if painting or carpeting a floor for example) or decide on the dimensions of the project (if constructing a bookcase or a cedar chest for example) and bring the measurements to class.
  - Review the rubric that will be used to evaluate the project.

#### Task 2: Scale Drawings

- Complete this task after students have constructed 2-D scale drawings in Activity 2.
- Tell students to identify and label all objects that are part of the upgrade on the scale drawing.

#### Task 3: Supply List

- Provide store flyers for material selection and to determine the quantity of supplies required for the project.
- Demonstrate how to fill in the supply list using an example from the flyers or a package. Students use the flyers to complete any sections of the supply list they can. Tell them that coverage data will be collected during the store visit. Check to ensure that lists are complete.
- Demonstrate appropriate label reading prior to the store visit using a paint can as an example.

#### Task 4: Store Visit

- Ensure that students have brought the supply list in Sample Worksheet 2, clipboards, and pencils.
- Provide assistance reading labels for coverage and completing the price column of the supply list. In most cases the quantity will be calculated in Task 5.
- Ensure that the Supply, Label Information and Unit Price columns of the Supply List are complete before leaving the store.

#### Task 5: Project Costs

- Review method of calculating the amount of supplies required using label information and calculating costs using unit price with an example. For instance: Calculate the number of cans of paint needed to paint a classroom wall using the label information; then, demonstrate how the unit price can be used to calculate the total paint costs. Model the ways spreadsheets or calculators can be used to calculate both the quantity and supply costs. Post these instructions for student reference.
- Ensure that calculations are adjusted so that students are purchasing full packages, cans of paint, etc.
- Assist students as they adjust their material list in order to stay within their budget.

#### Task 6: Evaluating/Presenting

- Discuss the reflection and presentation prompts in Sample Worksheet 4

### **Student Activity**

Students:

The project consists of six 75-minute tasks: a project proposal; a scale diagram using technology; a supply list; a store visit; the calculation of project costs; project evaluation/presentation.

#### Task 1: Project Proposal

- Review household improvement magazines and books and decide on a project to investigate such as redecorating a room, tiling a floor, building a bookcase, refinishing furniture.
- Complete the project proposal in Sample Worksheet 1.

### **Sample Worksheet 1**

#### Project Proposal

Describe your project:

Draw a sketch of your project:

You will complete your project during class time. We have agreed on the following due dates:

1. Proposal \_\_\_\_\_
2. Scale Drawing \_\_\_\_\_ (Bring measurements to class on this date.)
3. Supply List/ Quantity \_\_\_\_\_

4. Field Trip (Store Visit) \_\_\_\_\_
5. Project Costs \_\_\_\_\_
6. Presentation \_\_\_\_\_

Budget amount: \_\_\_\_\_

Signed: \_\_\_\_\_ (Student) \_\_\_\_\_ (Teacher)

**Task 2: Scale Drawing**

- Construct a scale drawing of the project using GSP or by hand.

**Task 3: Supply List**

- Determine which supplies are needed to construct the project (including gloves, drop cloths, etc.) and complete the supply list in Sample Worksheet 2.

**Sample Worksheet 2 (Expand this Supply List to include more rows)**

Supply	Quantity	Label information (Coverage)	Unit Price

- Determine the quantity required using the information in the flyers and formulas, (i.e., area, perimeter) or spreadsheets with formulas if the information is available in the flyer.

**Task 4: Store Visit**

- Students complete the label information and price section of the supply list.
- Students collect samples, e.g., paint chips, wallpaper, if desired for the presentation.

**Task 5: Project Costs**

- Calculate the Quantity column in the Supply List using the Label Information column.
- Estimate project costs using the Quantity column and Unit Price in the supply list.
- Enter the estimate in the spreadsheet in Sample Worksheet 3 then calculate total project costs.
- Review project costs and make adjustments in order to stay within the budget.

**Sample Worksheet 3 (Expand to include more rows)**

	A	B	C	D	E
1	Supply	Quantity	Unit Price	Project Costs	Estimate:
2				=B2 *C2	
3					
4			Sub Total	=SUM(D2:D3)	
			Taxes	=D4*.15	
			Total	=D4 + D5	Budget Amount:

**Task 6: Project Evaluation/Presentation**

- Collect and organize completed worksheets and prepare to present the proposal.
- Reflect on the work and present the proposal using the prompts in Sample Worksheet 4.

**Sample Worksheet 4**

Reflecting on my work

I am proud of...

I need to get better at....

Next time I would...

Presenting my Project

My project was about...

Some choices I had to make were...

The cost of the project was over/under the budget. I had to...

---

## Assessment & Evaluation of Student Achievement

Students require formative feedback on the reasonableness of their project proposal prior to the construction of scale drawings. Assess the project cost calculations and the accuracy of their scale drawings under Knowledge/Understanding. The decision-making required to stay within the budget can be evaluated under Problem Solving. The degree of clarity in their project presentation could be assessed under Communication. The selection of an appropriate scale and using it to construct a scale drawing can be assessed under Application.

## Accommodations

Allow students to provide verbal descriptions or use point form.

## Resources

<http://www.cmhc.ca/banner1/> provides project ideas.

<http://www.rona.ca/> provides on-line home improvement catalogues.

Home Improvement Store flyers.

Readers Digest, New Complete Do-It-Yourself Manual. Montreal: Readers Digest Canada 1991.  
ISBN: 0888501781

## Activity 6.2: Make Room!

**Time:** 1.5 hours

## Description

Students measure the classroom, choose an appropriate scale, and construct a two-dimensional scale drawing of the room using *Geometer's Sketchpad* (GSP). A three-dimensional drawing of the interior is created with drawing or design software.

## Strand(s) & Learning Expectations

### Ontario Catholic School Graduate Expectations

CGE4b - a self-directed, responsible, life-long learner who demonstrates flexibility and adaptability.

**Strand(s):** Applications of Measurement and Geometry

### Overall Expectations

AMV.02 - solve problems involving measurement and design.

### Specific Expectations

AM2.05 - make a two-dimensional scale drawing of a room, using design, or drawing software effectively;

AM2.06 - create a three-dimensional drawing of the interior of a room, using design or drawing software effectively.

## Prior Knowledge & Skills

- Students must know how to construct lines and use the measure and graph menus on *GSP*.

## Planning Notes

- Book the computer lab or provide access to classroom computers with drawing software.
- Set the distance units to centimetres or inches and the precision to tenths if using *GSP*.
- Students require rulers, calculators, metric, and imperial measuring tapes, grid and plain paper.
- Provide 2-D metric and imperial scale drawings such as maps and floor plans and 3-D drawings.
- Prepare Sample Worksheets.

---

## Teaching/Learning Strategies

### Teacher Facilitation

- Lead a whole-class discussion, using familiar examples of scale drawings in two dimensions. For each example students discuss why scale diagrams are useful, why the scale is appropriate, and how the scale is used to determine the measurements in the diagrams.
- Facilitate the completion of the practice exercises in Sample Worksheet 1 by making reference to the scales used in maps and floor plans and constructing a scale drawing as an example.
- Engage students in a whole-class discussion about choosing an appropriate scale for the classroom. There will be more than one appropriate scale. Model the use of both metric and imperial scale units with examples drawn on chart grid paper. Review Sample Worksheet 2, Part One. Check grid paper scale drawings to ensure that the measurements and scale are accurate.
- Demonstrate how to use the GSP instructions in Sample Worksheet 2 Part Two with an example.
- Provide time to complete the reconstruction of the scale drawing.
- Demonstrate the construction of the 3-D drawing of the room. More than one strategy should be provided so that students can make an informed choice. One way to begin is with a grid-paper scale drawing of a wall. Students cut out the drawing and trace it once to form one wall then slide the template left or right and trace again to draw the opposite wall. Connecting the corners of the two templates creates the third dimension. Another strategy uses one-point perspective to construct the second wall.
- Both *GSP* and *Paint* can be used to reproduce either of these 3-D construction techniques. Demonstrate both technologies so that students can make an informed choice.

### Student Activity

- Measure the classroom and create a scale drawing of the classroom using grid paper.
- Recreate the scale drawing using drawing software and print the drawing.
- Create a three-dimensional drawing of the interior using drawing software.

### Sample Worksheet 1 (Expand to include more examples)

Resource	Scale	Real Measurement	Scale Measurement
	100:1	15 m	
		8 feet	1 inch

1. Measure 2 objects in the classroom, e.g., textbook, desk, computer screen.
2. Sketch and label a diagram of the objects you measured.
3. Decide on an appropriate scale and explain why you made this choice.
3. Using grid paper, make a scale drawing of the object.
4. Label the sides with the actual measurements.

### Sample Worksheet 2: Scale Drawing of a Room

Part One: Measure the room and calculate the scale measurements.

1. Draw a sketch of the perimeter of the floor of the classroom.
2. Measure the perimeter and height of the classroom. Label the sketch and complete the table.
3. Add the measurements for the two objects you measured in Sample Worksheet 1.
4. Determine an appropriate scale. Use the scale to complete the table:

Scale:	Real Measurements	Scale Measurements
Classroom length		
Classroom width		
Classroom height		

5. Using grid paper make a scale drawing of the room.

---

Part Two: Reconstruct the scale drawing. (The following instructions use *GSP*)

1. Create the grid paper: Select Graph: Show Grid and Hide Axes.
2. Create the corners: Place points at a grid mark close to the 4 corners in the paper scale drawing.
3. Construct a rectangle: Holding the shift key, select the points. Select Construct: Segment.
4. Measure the sides: Holding the shift key, select the sides in order. Select Measure: Length.
5. Adjust the measurements: Select Graph: Hide Grid. Select a corner and drag until the measurements display accurate scale lengths. Repeat as required then Select Graph: Show Grid.

### **Assessment & Evaluation of Student Achievement**

Formative assessment of the knowledge required to choose an appropriate scale for the classroom can be made to provide feedback to students prior to the construction of the scale drawing of the home improvement project in Task 2 of Activity 1.

### **Accommodations**

Students could construct rectangular rooms. Provide access to scripts for rectangles if using *GSP* to construct the 2-D and 3-D drawings. Allow students to submit the grid paper scale drawings.

### **Resources**

*Paint* (Windows 95/98 drawing program), *Geometer's Sketchpad* or other drawing software.

TABS+ 3-D Modeling is a design and modeling software suitable for these constructions.

<http://www.nycenet.edu/oit/math-kitecture/index.htm> provides instructional ideas for scale drawings.

<http://mathforum.org/workshops/sum98/participants/sanders/> gives three-dimensional drawing ideas.

## **Activity 6.3: Objects are Larger than They Appear**

**Time:** 3.75 hours

### **Description**

Students design and construct a 3-D scale model of an area of personal interest such as a bridge, garden, or cabinet. The model construction is divided into four parts. First, students select work groups by interest and plan the model by preparing sketches of all views. An appropriate scale is determined and scale conversions are calculated and applied to the construction of a prototype in the second part. In the third part modelling materials are applied to the prototype in order to provide structural reinforcement and decorative design. Students complete the activity with a project reflection that assesses application of measurement skills and teamwork.

### **Strand(s) & Learning Expectations**

#### **Ontario Catholic School Graduate Expectations**

CGE5a - a collaborative contributor who works effectively as an interdependent team member.

**Strand(s):** Applications of Measurement and Geometry

#### **Overall Expectations**

AMV.02 - solve problems involving measurement and design.

#### **Specific Expectations**

AM2.07 - construct, with reasonable accuracy, a scale model of an environment of personal interest.

### **Prior Knowledge & Skills**

- Students must be able to use the metric system.

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## Planning Notes

- Provide 3-D models such as cars, trains, and bridges with the scale indicated.
- Provide scaled objects such as nested boxes, rectangular and trapezoidal prisms.
- Students will work in small groups.
- Provide access to one computer per group with a spreadsheet program to calculate the scaled dimensions installed.
- Provide rulers, tape measurers, metre sticks, and 1 cm grid paper.
- Prepare Sample Worksheet 1.
- Provide suitable model building materials such as popsicle sticks, foam board, Bristol board, markers, pencils, glue, tape, glue gun, and scissors.

## Teaching/Learning Strategies

### Teacher Facilitation

#### Day One:

- View 3-D models and discuss the choice of scale.
- Brainstorm ideas for models such as bridges, gardens or cabinets and sketch students' choices in 3-D onto chart paper (Use a separate sheet of chart paper for each model building idea). Evaluate the reasonableness of each model idea in light of the timelines for the activity and revise accordingly.
- Discuss approximate “real” measurements of the dimensions for these objects and add this information to the chart paper. Students choose their project by proceeding to the sheet of chart paper model ideas according to their interest. Direct each group member to complete Sample Worksheet 1 Part One and remind students to bring any measurements they may require to class the next day.
- Demonstrate how to plan the model construction using a filing cabinet (or similar classroom object) as an example. Following the outline in Sample Worksheet 1 Part Two, sketch all views of the cabinet (front, back, sides, top), measure, and label the dimensions. Provide concrete strategies for determining an appropriate scale. One strategy that encourages students to decide on the size of the model and then calculate the scale is as follows: Measure the largest dimension on the filing cabinet (e.g., height = 108 cm). Using their hands, students gesture the size the height will be on the model (e.g., 20 cm). This measurement will be the scaled length. Using a spreadsheet with formulas, show students how to determine the remaining scaled dimensions for the model. A spreadsheet is provided below however the calculations can be done effectively without a spreadsheet.

	<b>A</b>	<b>B</b>	<b>C</b>
<b>1</b>	Dimension to be scaled	Real Dimension	Scaled Dimension
<b>2</b>	Cabinet Height	108	20
<b>3</b>		<i>any real dimension</i>	=C2 * B3 / B2

- Record the scale dimensions beside the real measurements on the sketch.
- Provide time for students to practise choosing a scale and calculating the scaled dimensions using either a table or spreadsheet by completing Sample Worksheet 2.

#### Day Two:

- Review scale calculations using a table or spreadsheet by referencing the previous day's filing cabinet calculations and the practice calculations in Sample Worksheet 2.
- Review Sample Worksheet 1 Part Two. As students complete the worksheet, check the object views, the real dimensions, choice of scale, and calculations for accuracy.
- Demonstrate the construction of a grid-paper prototype using the filing cabinet scale calculations and sketches from the previous day. Create and cut out all grid templates and show how Bristol board will provide stability by gluing it on to the front of the model.
- Students should begin constructing the prototype when the scale dimensions are completed.

### Day Three:

- Monitor students and provide assistance with model construction challenges.
- Prompt students to be specific when completing Part four of Sample Worksheet 1.

#### Student Activity

Students complete Sample Worksheet 1 which requires that they:

- select a model project and group members by interest;
- sketch the model, record real dimensions, and determine an appropriate scale for the model;
- calculate the scale measurements and construct a prototype;
- complete a project reflection.

#### Sample Worksheet 1 (Expand to provide room for the sketches)

##### Part One: Planning the Model

Group Members:

Sketch:

Teacher Check\_\_

##### Part Two: Choosing an Appropriate Scale for the Model

1. Sketch all the views of the object (front, back, sides, top, bottom) and label with the actual dimensions:  
Teacher Check\_\_
2. Where is the largest dimension? \_\_\_\_\_. How long is it? \_\_\_\_\_
3. How many 1-cm grid squares would you like this to be on your model? \_\_\_\_\_
4. Enter these numbers in a table or spreadsheet. Calculate the length of all the model dimensions.
5. Place the scale dimensions beside the actual dimensions on all the views sketched in Part Two.  
Teacher Check\_\_

##### Part Three: Building a Grid-Paper Prototype and Constructing the Model

1. Using the scale dimensions, count grid squares to create a template for each surface.
2. Cut out the templates and label: front/back, left side/right side.
3. Hold the templates in place to check how your model will look. Adjust as necessary.  
Teacher Check\_\_
4. Glue Bristol board to the front of the grid templates.
5. Colour the exterior to represent the original object.
6. Assemble the surfaces with glue.

##### Part Four: Reflecting on your Work


I am proud of...

Next time, I will...

My group helped me....

I helped the group by...

#### Sample Worksheet 2

<p>A Television has the following dimensions:</p>  <p>70 cm 58 cm Front</p> <p>52cm 58cm Sides</p> <p>70cm 52cm Top</p>	<ol style="list-style-type: none"><li>1. Where is the largest length in the model?</li><li>2. How many grid squares will you represent this length in the model?</li><li>3. Calculate the scale dimensions of the television and add them to the sketch.</li></ol>
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#### Assessment & Evaluation of Student Achievement

Application can be assessed with the appropriateness of the choice of scale for the model and student's ability to apply it accurately to all dimensions in the completed model. Teamwork can be assessed by observing students as they work in groups to solve design and construction challenges and by assessing the project reflection in Sample Worksheet 1 Part Four.

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## Accommodations

Provide samples of different nets for the models. Allow students to describe or tell about the model. Allow students to use *TABS+* software.

## Resources

[www.scalemodel.net/](http://www.scalemodel.net/) – provides a list of scale model sites and related information.

## Activity 6.4: Signs of Symmetry

**Time:** 1.25 hours

### Description

The activity uses a cooperative learning strategy called Jigsaw to teach students how to create symmetrical patterns using the Transform menu on *GSP*. Expert groups learn to construct one of the transformations (translation, reflection, rotation, dilatation) and return to their home groups to teach the skill to their group members. Students apply these skills to a cooperative reconstruction of a logo.

### Strand(s) & Learning Expectations

#### Ontario Catholic School Graduate Expectations

CGE4b - a self-directed, responsible, life-long learner who demonstrates flexibility and adaptability;

CGE5a - a collaborative contributor who works effectively as an interdependent team member.

**Strand(s):** Applications of Measurement and Geometry

#### Overall Expectations

AMV.03 - apply transformation geometry in creating effective designs.

#### Specific Expectations

AM3.01 - describe the use of translations, reflection, rotation, and dilatations as they relate to symmetry and design in logos, with the aid of technology.

### Prior Knowledge & Skills

- Students have previous experience using *Geometer's Sketchpad* in the Grade 9 Mathematics courses.

### Planning Notes

- Book the computer lab or have classroom computers available.
- Prepare Appendix 6.4.1 – Symmetry; one copy per group
- Provide access to Escher art that demonstrates the use of transformations to create designs.
- Students work in groups of 4 (called home groups).
- Construct Appendix 6.4.2 – Learn to Draw Course using *GSP* on computers and prepare instructions; one per computer.
- Post *GSP* instructions for the Transform menu.
- Construct Appendix 6.4.3 – Transformations using *GSP* on computers.
- Laminate the logo in Appendix 6.4.4 – Logo; one copy per group and construct the logo template in Appendix 6.4.4 – Logo on computers.

- 
- Jigsaw is a cooperative learning strategy. Students form small groups (home groups). Each group member meets with one member from each of the other home groups to form an expert group. The expert group learns and practises one skill until they are experts. (Expert means that they would be able to explain and demonstrate the skill to someone else). Once they are experts this group returns to meet with their home group members to teach them what they have learned. In this way students learn many skills, and work cooperatively to complete a larger or more complex task than might be possible in a similar amount of time.

## Teaching/Learning Strategies

### Teacher Facilitation

- Introduce the terminology and physical motions associated with symmetrical pattern making through an activity with the home group as explained below.
- Distribute envelopes containing a template shape for making symmetrical patterns, a sheet of symmetrical patterns made with the shape, and names and descriptions of the symmetry to each group (A suggestion is found in Appendix 6.4.1 – Symmetry). Direct student groups to match the template with the symmetrical pattern and the name of the transformation that created the pattern. It is important for students to connect the name (slide, flip, turn, enlarge/reduce) with the motion that created the pattern. Suggest that students move the template across the patterns, adjusting the position and orientation of the shape in order to make a match. In this way the students make a physical connection between the pattern and the symmetry name. Encourage the groups to describe the physical motion they used to recreate the design.
- Discuss the application of the above transformations in the Escher art samples.
- The next part of the activity uses jigsaw to teach students how to use the Transform menu to create these transformations. Home groups are directed to send one person to each of the four computer “stations” where the *GSP* instructions outlined in Appendix 6.4.3 - Transformations using *GSP* have been installed. Two or three computers may be required at each “station” in order to accommodate two students per computer. Tell students that they will learn how to use one of the *GSP* symmetry tools (flip, slide, turn, rotate, enlarge/reduce) at their “station” and practise it by constructing the transformations they created concretely until they become “experts” with the tools.
- Direct students to move into their jigsaw positions. Once they are assembled at the computers explain that students will need to take a short Learn to Draw course.
- Direct students to open the file in Appendix 6.4.2 – Learn to Draw Course. Students follow the prompts in their jigsaw groups to learn to use the point, segment, and arrow keys in *GSP*. Once completed, the students should be able to follow the *GSP* directions in Appendix 6.4.3 – Transformations using *GSP*.
- Demonstrate the use of the symmetry tools in Appendix 6.4.3 – Transformations using *GSP* to the whole class using a Computer/TV monitor hook up. The direction lines for slides, the mirror lines for flips, the rotation points and enlarge/reduce points will work when you activate them. Begin with the shape used at the start of the activity. Demonstrate the slide, flip, rotation, and enlarge/reduce. Model the sequence of steps: Mark the line or point using the tool under the Transform menu; Select the shape; Choose the transformation under Transform following the prompts provided in Appendix 6.4.3 – Transformations using *GSP*.
- Direct students to begin work with their expert group. Remind students that experts are able to teach someone else their skill by explaining and demonstrating how the tool works. Provide sufficient time for students to become experts.
- Monitor the “stations” providing assistance and clarification when necessary.

- 
- After about 20 minutes students should return to their home groups and “teach” the rest of the group by demonstrating the transformation skills using the shapes in Appendix 6.4.3 – Transformations using *GSP* in addition to shapes that students construct themselves. Help students remain focused by providing them with a recording sheet on which they make notes on the four transformations.
  - Distribute a laminated copy of the logo in Appendix 6.4.4 – Logo, to each the home groups once all students have demonstrated how to construct slides, flips, and turns, and enlarge/reduce. Discuss the use of slides, flips, turns, and dilatations in this logo.
  - Direct students to open the file containing the logo template. The logo contains the four skills that were learned in the expert groups and shared with other students. Students should share the construction of the complete logo exchanging positions at the computer when their skill is required. Students should save the logo reconstruction using an appropriate file name.

### **Student Activity**

- Describe the use of flips, slides, turns, and enlargement/reduction in patterns using technology.
- reconstruct a logo using the Transform menu on *GSP*.

### **Assessment & Evaluation of Student Achievement**

Formative assessment of Knowledge/Understanding of transformations can be made by asking students to describe the transformations in the Escher art or in the logo reconstructions. Communication can be assessed with a peer assessment checklist as students teach each other in the home groups. The completion of the logo reconstruction in a given time frame can be assessed under Organization.

### **Accommodations**

Allow students to construct the *GSP* tasks in Appendix 6.4.3 – Transformations using *GSP* using concrete materials such as templates of the *GSP* shapes. Students may submit a concrete logo reconstruction using templates for tracing onto grid paper. Reinforce instructions with visual prompts or individually.

### **Resources**

For an on-line explanation of transformations and examples of symmetry go to:

<http://www.schools.ash.org.au/stkierans-manly/Classes/Yr6/6B/Symmetry/page1.html>

Gibbs, J. *Tribes: A new way of Learning Together*. Concord: Irwin Publishing, 1994.

ISBN 0-7725-2118-2

## **Activity 6.5: Personal Logo**

**Time:** 1.25 hours

### **Description**

Students apply their understanding of transformations to the analysis of symmetrical designs and the construction of a personal logo using *Geometer's Sketchpad*.

### **Strand(s) & Learning Expectations**

#### **Ontario Catholic School Graduate Expectations**

CGE3c - a reflective and creative thinker who thinks reflectively and creatively to evaluate situations and solve problems.

**Strand(s):** Applications of Measurement and Geometry

#### **Overall Expectations**

AMV.03 - apply transformation geometry in creating effective designs.

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### Specific Expectations

AM3.02 - analyse the geometric aspects of interesting and appealing applications;

AM3.03 - create a personal logo, using the mathematics of symmetry, translations, reflections, rotations, or dilations, with the aid of technology.

### Prior Knowledge & Skills

- Students must know how to construct symmetrical patterns using the transform menu on *GSP* and identify the sequence of transformations used to create symmetric patterns.

### Planning Notes

- Collect and laminate a set of symmetry resources for each group of four students. Each set should include a variety of the following: wallpaper, logos, quilt patterns, and carpet designs sorted by complexity.
- Provide access to the computer lab or classroom computers.
- Prepare the Sample Worksheet.
- Provide access to written and “visual” instructions for the Transform menu.

### Teaching/Learning Strategies

#### Teacher Facilitation

- Introduce the activity with an examination of symmetry resources posted in the classroom. Encourage students to identify the key features of these designs based on polygon shapes. They are to incorporate the four transformations and may reflect a cultural motif (carpet, pottery and tile designs), personal style, or product message (personal and business logos).
- Distribute a set of laminated symmetry resources to groups of four students.
- Distribute the Sample Worksheet and indicate that students are to analyse two symmetrical designs, one of which should be a logo.

#### Sample Worksheet 1

Attach a symmetric design and a logo and answer the following questions for each:

1. The logo has reflection symmetry if you can flip one half of the design onto the other. (Y/N)
2. The logo has translation symmetry if you can slide one part of the design onto itself. (Y/N)
3. The logo has rotational symmetry if you can turn the design onto itself at least once. (Y/N)
4. The logo uses dilations if one part of the design was enlarged or reduced. (Y/N)
  - Model the completion of the worksheet using a sample design. Tell students that the designs are sorted by complexity. Provide time for students to complete this worksheet.
  - Engage students in a whole-class discussion about the features of the logos they analysed in the worksheet and the purpose of a logo (advertise a product, make a personal statement) in order to provide ideas for their own logo. Using a polygon and for alphabet letters, create a personal symbol.
  - Remind students that the patterns they constructed in Activity 6.4 have provided them with some ideas with which to begin their own logo: turns can be used to create rosettes; letters can be created with flips and borders can be created with slides.
  - Review the rubric in Appendix 6.5.1 – Rubric for Transformations, with the students. Clarify with the students that their evaluation will be based on their knowledge of the transformation tools, the application of these tools to create an effective design, and a description of how the logo was created using appropriate vocabulary.
  - Direct students to move to the computers and begin their logo construction. Students should construct their logo with a grid displayed. Select Graph: Show Grid and Hide Axes.

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### **Student Activity**

- Analyse the geometric aspects of one symmetrical design and one logo.
- Construct a personal logo which demonstrates the application of at least three of the transformation techniques and conveys a personal message.
- Present the logo to the whole class and describe the transformations using the statements in the Sample Worksheet as a guide.

### **Assessment & Evaluation of Student Achievement**

A rubric to assess this activity is provided in Appendix 6.5.1. Knowledge/Understanding can be assessed by examining the skill with which they create symmetrical shapes using the Transform menu by selecting “Show all Hidden” under Display. Application can be assessed with the selection and coordination of the symmetry tools to create an effective logo design. Communication can be assessed through their description of how they designed the logo.

### **Accommodations**

Provide access to partial constructions or templates that provide students with a way to start should they request it. Students may construct the logo with concrete materials.

### **Resources**

[http://www.gopromos.com/idea\\_center/stock\\_art\\_alpha.asp?type=L](http://www.gopromos.com/idea_center/stock_art_alpha.asp?type=L) – provides access to corporate logos.

<http://www2.spsu.edu/math/tile/index.htm> – provides a selection of cultural designs.

<http://155.187.10.12/flags/flags.html> – displays flags of the world.

[www.style-line.com](http://www.style-line.com) – analyses the symmetry in hubcaps.

<http://mathforum.com/geometry/rugs/> – examines the symmetrical designs in rugs.

## **Activity 6.6: Tiles R Us**

**Time:** 3.75 hours

### **Description**

Students begin the activity with a whole class investigation to determine the characteristics of shapes that tile. These exploratory concrete experiences introduce students to the geometric problem solving that they will encounter when they construct tiling designs. Students apply and extend these geometric skills through the construction of two tiling designs using paper templates and technology. An emphasis is placed on using tactile, concrete materials in order that students solve these geometric problems through physical movement. A variety of technologies, requiring various skill levels, are provided as both construction tools and to enhance designs.

### **Strand(s) & Learning Expectations**

#### **Ontario Catholic School Graduate Expectations**

CGE4f - a self-directed, responsible, life-long learner who applies effective communication, decision-making, problem-solving, time and resource management skills;

CGE5h - a collaborative contributor who applies skills for employability, self-employment, and entrepreneurship relative to Christian vocation.

**Strand(s):** Applications of Measurement and Geometry

#### **Overall Expectations**

AMV.03 - apply transformation geometry in creating effective designs.

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### Specific Expectations

AM3.04 - determine, through investigations, using concrete materials and technology, the characteristics of shapes that will tile the plane;

AM3.05 - create designs involving tiling patterns, using technology.

### Prior Knowledge & Skills

- Experience with the Transform Menu and the left hand Toolbox is required in order to select, rotate, and drag objects on the screen if *GSP* is used for tiling. *CorelDraw 5* is an efficient alternative that does not require a sophisticated sequencing of tools and procedures.
- Experience with the *Paint* program will simplify the construction of Escher-like Art.

### Planning Notes

- Book the computer lab or provide classroom computers with *Paint*, *CorelDraw 5* and *GSP* installed.
- Construct the shapes in Sample Worksheet 2 on the computers using both *Geometer's Sketchpad* and *Corel Draw 5* and laminate card stock templates of these shapes (a few of each one so they can be shared) in a size that is suitable for tracing and creating paper and pencil designs.
- Gather and post tiling designs such as quilts, interlocking bricks, Escher art, and ceramic tiles.
- Provide a set of pattern blocks (10-15 of each block) for every four students.
- Prepare the technology instructions in Appendix 6.6.1 – Tiling Instructions.
- Prepare Sample Worksheets.
- Prepare sets of four index cards with the following pictures: 1 of 4 different triangles, 1 of 4 different quadrilaterals, etc., in sufficient number to provide one card per student to be used to form groups.
- Provide cardstock paper for constructing the Escher-like tiling templates.
- Provide  $8\frac{1}{2} \times 11$  blank paper, pencils, coloured pencils, scissors, card-stock paper, and tape.

### Teaching/Learning Strategies

#### Teacher Facilitation

- Introduce the activity with discussion about the features of tiling designs using ceramic tiles, Escher art, and interlocking bricks as examples. Prompt student discussion with guiding questions that encourage students to consider the common features of all the designs: no gaps or overlaps, and repeating patterns of one or many shapes that cover the entire surface.
- Record the characteristics of tiling patterns on chart paper and post within the room.
- Arrange students in groups of four using a strategy that involves matching polygons of the same kind (see Planning Notes) and provide each group with a set of patterns blocks.
- Instruct students to make patterns with their blocks leaving no gaps or overlaps. When completed, encourage them to share the results with the whole class, rotating around the room as they observe each other's work and share design plans. Prompt student discussions with questions such as: Which shapes fit together easily? Which shapes don't fit together? Which shapes will make patterns by themselves?
- Distribute Sample Worksheet 1 and review the activity with the students. This activity is an extension of the exploratory activity just completed as a whole class. It is suggested that group members divide the investigations among themselves in order that they benefit from multiple experiences. These experiences prepare students for the types of geometric problem-solving that will be required to complete the tiling designs in Sample Worksheets 2 and 3. Encourage students to use trial and error and to consider many combinations. It is a challenge to create tilings with just two or three different blocks. Assist students who are having difficulty by suggesting a way to start. Share results and review and reinforce the concepts that were learned. Refer to the tiling resources that were viewed at the beginning of the activity and ask students to consider questions such as: What other tile shapes might create tiling designs? Do you think you have to use polygons?

- Use this discussion to introduce the last part of the activity during which students create tilings using two methods: tracing templates and using Escher drawing techniques.
- Divide the grouped students into two large groups for the remainder of the activity.
- Distribute Sample Worksheets 2 and 3 to both groups and review the expectations: In Sample Worksheet 2 students choose a template of a shape from List 1 or List 2 and create a tiling design by tracing it on to paper. Tell students that the shapes in List 1 create designs using translations (easy) whereas the shapes in List 2 require a combination of rotations and translations (challenging). Students create a tiling design using one of the templates and demonstrate the reconstruction of the design with *GSP* using the instructions in Appendix 6.6.1 – Tiling Instructions, or *CorelDraw 5* as an example. Tilings that use a shape from List 2 require previous experience and skill with the rotation tool on *GSP*. *CorelDraw* is an effective and appropriate alternative. Demonstrate the technology by constructing a tiling design using *GSP* and *CorelDraw 5*.
- In Sample Worksheet 3 students create an Escher-like template and trace it to create a free-form tiling design. Students begin with a cardstock rectangle and create a free-form template by cutting and rearranging the cut out pieces. Create a tiling design by constructing a template and demonstrate the reconstruction of the design with *Paint* as an example.
- Tell students that one of the groups will start with Sample Worksheet 2 and the other group will start with Sample Worksheet 3. They will switch to the other Worksheet part way.

### Students Activity

- Determine the characteristics of shapes that tile using pattern blocks through the investigations outlined in Sample Worksheet 1.
- Create tiling designs using concrete materials and technology as outlined in Sample Worksheets 2 and 3 using the technology guides provided in Appendix 6.6.1 – Tiling Instructions.

### Sample Worksheet 1

#### Part One: Tiling Designs that Use One Pattern Block

1. Choose one pattern block and trace the outline here:
2. Trace the pattern blocks chosen by the members of your group:
3. Select 10 more of your block. Create a tiling pattern.
4. Look at the tiling designs created by your group members. Which ones tile?...don't tile?

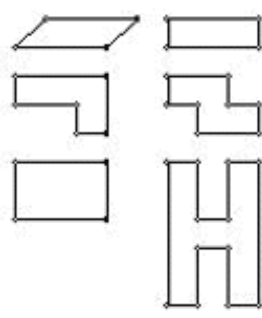
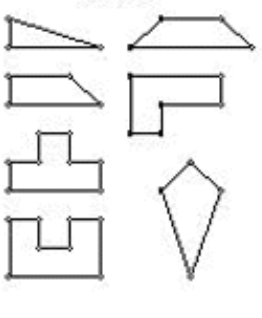
#### Part Two: Tiling Designs that Use Two Pattern Blocks

1. Choose two different pattern blocks and trace their outline here:
2. Trace the pattern blocks chosen by the members of your group:
3. Select 10 more of each of these blocks. Create a tiling pattern.
4. Look at the tiling designs created by your group members. Which ones tile?...don't tile?


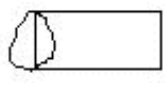



#### Part Three: Tiling Designs that Use Three Pattern Blocks

1. Choose three different pattern blocks and trace the outline here:
2. Trace the pattern blocks chosen by the members of your group:
3. Select 10 more of your block. Create a tiling pattern.
4. Look at the tiling designs created by your group members. Which ones tile?...don't tile?

**Sample Worksheet 2: Students draw a tiling design using a laminated template**

<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>LIST ONE</p>  </div> <div style="text-align: center;"> <p>LIST TWO</p>  </div> </div>	<ol style="list-style-type: none"> <li>1. Choose a laminated template of a shape from List One or List Two.</li> <li>2. Trace the template onto a sheet of paper.</li> <li>3. Reposition the template next to the traced outline. Trace the outline. Repeat until the page is filled.</li> <li>4. Colour the design.</li> <li>5. Reconstruct the paper and pencil design using either GSP or CorelDraw 5</li> <li>6. Save and print your design.</li> </ol>
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**Sample worksheet 3: How to create an Escher-like template**

<p>Create a paper template: Select a card stock rectangle.</p>		<p>Create a template with the Paint Activity program: Select the Rectangle Tool: Click and drag to create a rectangle. Select "Fill with Colour"</p>
<p>Draw an altered edge on the left side of the rectangle.</p>		<p>Select the Free Form Select Tool: Draw a line through the top and bottom at back to the start.</p>
<p>Cut along the line. Slide to the other side. Tape edges.</p>		<p>Click and drag the cut out to the opposite side of the rectangle.</p>
<p>Repeat the above steps on the upper edge.</p>		<p>Repeat the above steps on the upper edge and position the cut piece on the lower side.</p>
<p>Trace and reposition the template to create a tiling pattern. Add colour and details.</p>		<p>Select the Scissors Tool: Draw a rectangle around the figure and copy it. Drag the copy away from the original and colour it. Repeat the above to tile the area.</p>

**Assessment & Evaluation of Student Achievement**

Assess the student's ability to select and sequence appropriate transformations to reconstruct the tiling design using technology under Problem Solving.

**Resources**

Lee, Kevin. *TesselMania*, 1995 is a computer program that constructs tiling designs easily.

For information about Escher art and constructing tilings – <http://library.thinkquest.org/16661/> Once at the site, select Totally Tessellations, An Introduction to Tessellations and <http://www.izzy.net/~jc/EscherTiles/EscherTiles.html>

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## Activity 6.7: Summative Activity: All Tiled Up!

**Time:** 1.25 hours

### Description

Using a case scenario, students construct a tiling design and investigate the costs of a flooring project using drawing software and spreadsheet technology. A proposal that includes a scale drawing, a tiling design, project costs and an analysis of the budget is submitted for evaluation.

### Strand(s) & Learning Expectations

#### Ontario Catholic School Graduate Expectations

CGE5h - a collaborative contributor who applies skills for employability, self-employment and entrepreneurship relative to a Christian vocation.

**Strand(s):** Applications of Measurement and Geometry

#### Overall Expectations

AMV.02 - solve problems involving measurement and design;

AMV.03 - apply transformation geometry in creating effective designs.

#### Specific Expectations

AM2.05 - make a two-dimensional scale drawing of a room, using design, or drawing software effectively;

AM2.09 - investigate the making of a household improvement, design the improvement, and estimate and calculate the cost, using technology;

AM3.02 - describe the geometric aspects of interesting and appealing applications;

AM3.05 - create designs involving tiling patterns, using technology.

### Prior Knowledge & Skills

- It is expected that students know how to construct a scale drawing and tiling designs using *GSP*.

### Planning Notes

- Book the computer lab or provide classroom computers.
- Construct the tiles for the case scenario using drawing software.
- Install the spreadsheet in Sample Worksheet 1 on the computers.
- Prepare the case scenario in Sample Worksheet 2.

### Teaching/Learning Strategies

#### Teacher Facilitation

- Ensure that students have access to their work from Activities 6.1 to 6.6.
- Distribute and read the case scenario. Review the function of the materials in the supply list and clarify the directions: they may create a design with one or both tiles and their evaluation will consider the complexity of this choice. Tiles are boxed by any selection of pieces. Students should calculate the number of boxes required based on the floor area only, not the area of the individual tiles.
- Demonstrate the use of the spreadsheet in Sample Worksheet 1 at the computers.

#### Student Activity

Complete a case scenario and submit a disc or printed documents for evaluation.

- Draw a room to scale using drawing software.
- Construct a tiling design using drawing software.
- Estimate and calculate project costs for a tiled surface and a vinyl flooring surface.
- Prepare a purchase recommendation based on an analysis of the flooring options and the budget.

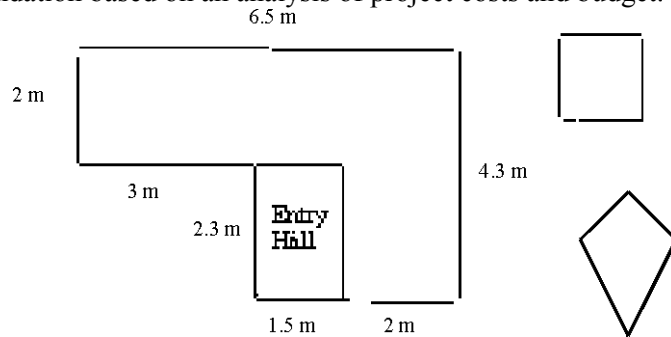
**Sample Worksheet 1: Expand this spreadsheet to provide more rows**

	A	B	C	D
1	Total tiled area	(enter total area)	Number of boxes of tiles	= B1/.8
2	Tiling Supplies	Quantity	Unit Price	Cost
3				
4				
5			Subtotal	=SUM(D3:D4)
6			Tax (GST/PST)	=.15*D5
7			Total Project Costs	=D5+D6

**Sample Worksheet 2: Case Scenario**

A homeowner plans to upgrade an entrance hall. While removing the baseboard and flooring materials, an old tiled floor was discovered. At the present time the homeowner must decide whether to replace the tile with vinyl flooring or restore the old tiled surface. \$150 has been budgeted for the upgrade but the homeowner would consider exceeding the budget slightly. A sketch of the hallway, tiles and a supply list is provided below. Complete a proposal for this project. Your proposal must include:

- a scale drawing of the room using drawing software.
- a tiling design using drawing software and an explanation of how the design was created.
- an estimate of project cost and total costs calculated using a spreadsheet.
- a purchase recommendation based on an analysis of project costs and budget.



Supply List	Coverage	Price	Notes
Tiles	0.8 m <sup>2</sup> *	\$22.50/box	*A box contains an assortment of tiles
Vinyl flooring (pre-cut roll end)	1.8 m x 2.7 m	\$84.00plus \$25.00**	** The cost of levelling the sub-floor. This is required in order to keep the 5-year guarantee.
Tile adhesive:	1.3 m <sup>2</sup> /L	\$11.95/7.6L pail	
Tile grout	3 m <sup>2</sup> /box	\$10.95/box	
Vinyl adhesive	70 m <sup>2</sup> /pail	\$10.99/3.8L pail	
Trowel	NA	\$3.86	
gloves	NA	\$5.00	
cleaning solutions	4L	\$11.99	

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### **Assessment & Evaluation of Student Achievement**


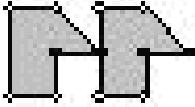



- A rubric is provided in Appendix 6.7.1 – Sample Rubric. Knowledge/Understanding can be assessed through the choice of scale, the calculations, and the construction of the scale drawing. Application can be assessed by examining the student’s ability to use the spreadsheet to evaluate project costs and make a purchase recommendation. Problem Solving can be evaluated through the analysis and justification of the purchase recommendation and through the selection of the tools required to create a tiling design. Communication can be evaluated by the clarity of the arguments given in the purchase recommendation.

### **Accommodations**

- Provide scripts for rectangles and allow students to construct the design with concrete materials. Allow students to verbally present their analysis of the budget.

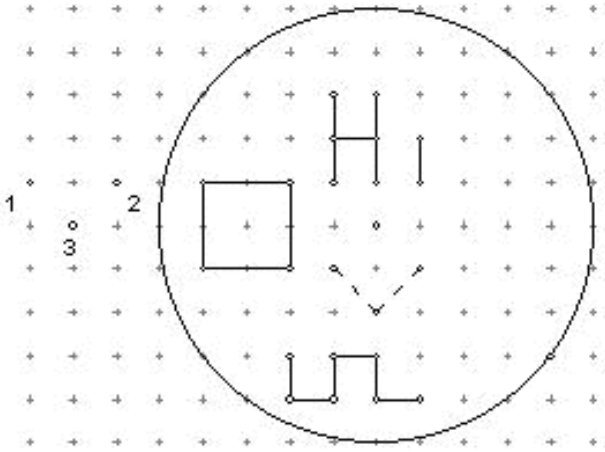
## Appendix 6.4.1

### Symmetry

	<b>Create and cut out the name and definition strips below. Make a template of the shape to the left in a size suitable for tracing the patterns below.</b>		
Slides	The pattern is created by sliding the shape across the page		
Flips	The pattern is created by flipping the shape		
Turns	The pattern is created by turning the shape		
Enlarge/Reduce	The pattern is created by changing the size		
			

## Appendix 6.4.2

### Learn to Draw Course

	<p><u>Drawing:</u> Using the segment tool, click on point 1 and drag to point 2. Release. Click and drag to point 3. Release. Click and drag back to point 1.</p> <ul style="list-style-type: none"> <li>- Make another eye and continue the teeth pattern.</li> <li>- Put a point in the eye using the point tool.</li> </ul> <p><u>Selecting Objects:</u> Click and drag a box around the 123 triangle. Drag it onto the face to make a nose.</p> <ul style="list-style-type: none"> <li>- Hold down the shift key, select the eye then the line above. Repeat with the other eye. Click on Display: select Animate and choose Animate.</li> </ul> <p><u>Hiding Objects:</u> Select the word Hi. Under Display: Select Hide Objects</p>
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## Appendix 6.4.3

### Transformations using *GSP*

Prepare instructions for one transformation (slide, flip, turns, or dilatations) at each computer station.

**Construct these shapes on *GSP* and align them vertically near the left side of the screen**



**To construct Slides:** Draw a line using the segment tool below and to the right of the shapes.

1. Holding the shift key down, select the left then right endpoint of the line.
2. Under Transform: Select Mark Vector. Select the shape above the line.
3. Under Transform: Select Translate. Click OK.
4. Repeat with the remaining shapes.
5. Choose one shape: draw a line that points downward to the right and slide the shape.
6. Make your own shape and use what you have learned to slide it.

**To construct Flips:** Draw a line using the segment tool to the right of each of the shapes.

1. Select the line to the right of a shape. Under Transform: Select Mark Mirror. Select the shape.
2. Under Transform: Select Reflect.
3. Choose one shape: draw a line underneath it and flip the shape.
4. Make your own shape. Use what you have learned to flip it.

**Turns:** Draw a point to the right of each shape.

1. Select the point to the right of the shape. Under Transform: Select Mark Centre.
2. Select the shape. Under Transform Select Rotate. (Choose 90 degrees). Repeat two times.
3. Drag the point to the left until it touches the shape. What do you notice?
4. Repeat using a different angle (45 -90 or -45 degrees).
5. Make your own shape. Use what you have learned to rotate it.

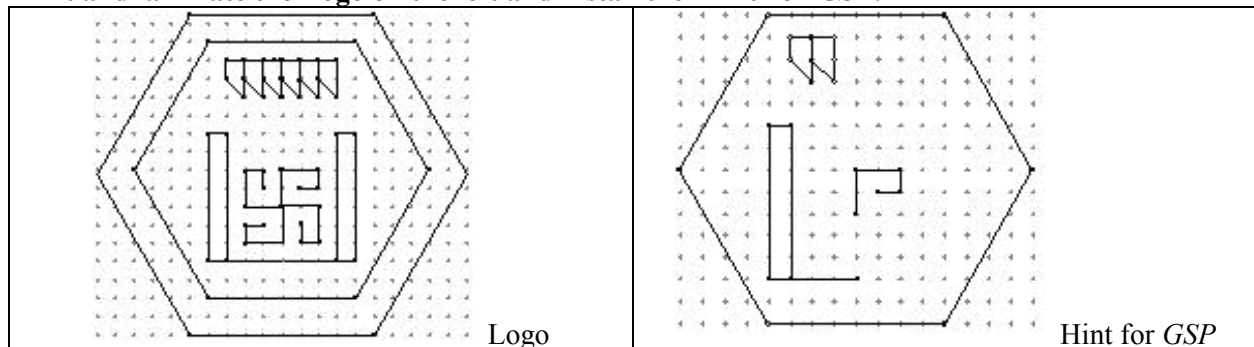
**Dilatation:** Draw a point the left of the shape.

1. Select the point to the left of the shape. Under Transform: Select Mark Centre.
2. Select the shape. Under Transform Select Dilate. (Choose 1.5).
3. Drag the point to the left until the shapes sit side by side then drag it to the centre of the shape.
4. Repeat with the rest of the shapes.
5. Make your own shape and reduce it 3 times by selecting 0.75, 0.5 and 0.25 for the scale factor.

## Appendix 6.4.4

### Logo

Print and laminate the Logo on the left and install the “hint” on *GSP*.



### Appendix 6.5.1 – Rubric for Transformations

Criteria	Level 1 (50-59%)	Level 2 (60-69%)	Level 3 (70-79%)	Level 4 (80-100%)
<b>Knowledge/ Understanding</b> - constructs the following: flip, slide, turn, enlarge, and reduce using the Transform menu on <i>GSP</i>	- demonstrates limited Understanding of using the Transform menu to create shapes	- demonstrates some understanding of using the Transform menu to create shapes	- demonstrates a considerable understanding of using the Transform menu to create shapes	- demonstrates a thorough understanding of using the transform menu to create shapes
<b>Application</b> - selecting and coordinating a variety of symmetry tools to create an effective logo design	- uses selection and arrangement of the symmetry tools with limited effectiveness	- uses inconsistent selection and arrangement of the symmetry tools according to an overall plan with some effectiveness	- makes selection and arrangement of the symmetry tools co-ordinating a variety of ideas under an overall plan	- makes selection and arrangement of the symmetry tools according to a sophisticated design plan
<b>Communication</b> - appropriate use of mathematical vocabulary to describe the transformations in the logo	- rarely uses mathematical words correctly applied to describe the transformations	- sometimes uses or applies mathematical words correctly to describe the transformations	- regularly uses appropriate mathematical words to describe the transformations	- consistently uses appropriate mathematical words to describe the transformations

**Note:** A student whose achievement is below Level 1 (50%) has not met the expectations for this assignment or activity.

### Appendix 6.6.1 – Tiling Instructions

<p><u><b>GSP Instructions for shapes in List One</b></u></p> <ol style="list-style-type: none"> <li>1. Select and copy the shape that matches the template used for the paper-and-pencil tiling. Paste the shape in the lower left corner of a new sketch. Make 4 copies. Colour the interior.</li> <li>2. Select and drag one shape next to another until it meets edge to edge.</li> <li>3. Repeat with the remaining copies. Copy/Paste large sections to complete the design. Save often.</li> </ol>
<p><u><b>GSP Instructions for Shapes in List Two</b></u></p> <ol style="list-style-type: none"> <li>1. Select and copy the shape that matches the template used for the paper and pencil tiling. Paste the shape in the lower left corner of a new sketch. Make 4 copies. Colour the interior.</li> <li>2. First, on one shape select one point. Under Transform, choose Mark Centre. Second, select the shape then choose the Rotate tool (under the selection arrow on the left toolbar). Third, move the pointer towards the point around which you will rotate. When the pointer becomes a horizontal arrow, press and hold the mouse down. Drag the selection around the centre of rotation until it is in the position you want. Release the mouse button. Fourth, change the Rotate tool to the selection arrow and select the shape. Drag the shape into position so it meets edge to edge.</li> <li>3. Repeat with the remaining copies. Copy/Paste large sections to complete the design. (Save often.)</li> </ol>

## Appendix 6.7.1

### Rubric for Summative Activity: Flooring Project

Criteria	Level 1 (50-59%)	Level 2 (60-69%)	Level 3 (70-79%)	Level 4 (80-100%)
<b>Knowledge/ Understanding</b> Construction of a scale drawing for the floor space	- limited knowledge of scale drawing is demonstrated	- some knowledge of scale drawing is demonstrated	- considerable knowledge of scale drawing is demonstrated	- thorough knowledge of scale drawing is demonstrated
<b>Problem Solving</b> Analysis and justification of the purchase recommendation  Selection and sequencing of tools required to create a tiling design	- makes recommendations with limited justification  - selection and sequencing of tools suggest limited understanding	- makes reasonable recommendations and provides some justification  - the tools selected are appropriate for some of the tiles or sequenced sometimes	- makes appropriate recommendations and provides considerable justification  - the tools selected are appropriate and correctly sequenced most of the time	- make appropriate recommendations and provides thorough justification  - the tools selected are appropriate and are correctly sequenced all or almost all of the time
<b>Application</b> Use of the spreadsheet to calculate and evaluate project costs  Make appropriate purchase recommendations	- spreadsheet calculations had limited use for calculating costs  - purchase recommendation has limited validity	- spreadsheet calculations lead to some use for calculating costs  - purchase recommendation has some validity	- spreadsheet calculations consider most options  - purchase recommendation has a considerable validity	- spreadsheet calculations are complete and evaluated within the context of the problem  - lead to a high quality recommendation
<b>Communication</b> Degree of clarity in the arguments behind their purchase recommendation	- provides arguments with limited clarity	- provides arguments with some clarity	- provides arguments with considerable clarity	- provides arguments with high degree of clarity that are fully justified

**Note:** A student whose achievement is below Level 1 (50%) has not met the expectations for this assignment or activity.