The Ontario Curriculum – Exemplars
Grade 3

Mathematics

Samples of Student Work: A Resource for Teachers

2002
## Contents

**Introduction** ................................................................. 3
Purpose of This Document ................................................. 4
Features of This Document .................................................. 4
The Tasks ................................................................. 5
The Rubrics ............................................................. 5
Development of the Tasks .................................................. 7
Assessment and Selection of the Samples ................................. 8
Use of the Student Samples .................................................. 8
  Teachers and Administrators ........................................... 8
  Parents ............................................................... 9
  Students ............................................................. 10

**Measurement / Patterning and Algebra / Data Management and Probability** ............................................. 11
Lots of Coins! ............................................................ 12
  The Task ........................................................... 12
  Expectations ......................................................... 12
  Prior Knowledge and Skills ........................................ 13
  Task Rubric .......................................................... 14
  Student Samples ..................................................... 16
  Teacher Package ...................................................... 53

**Geometry and Spatial Sense** ........................................... 59
Exploring Designs ........................................................ 60
  The Task ........................................................... 60
  Expectations ......................................................... 60
  Prior Knowledge and Skills ........................................ 61
  Task Rubric .......................................................... 62
  Student Task Instructions .......................................... 64
  Student Samples ..................................................... 65
  Teacher Package ...................................................... 96

**Patterning and Algebra** .................................................. 103
Patterns on the Hundreds Board ......................................... 104
  The Task ........................................................... 104
  Expectations ......................................................... 104
  Prior Knowledge and Skills ........................................ 105
  Task Rubric .......................................................... 106
  Student Samples ..................................................... 107
  Teacher Package ...................................................... 156

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Introduction

In 1997, the Ministry of Education and Training published a new mathematics curriculum policy document for Ontario elementary students entitled *The Ontario Curriculum, Grades 1–8: Mathematics, 1997*. The new curriculum is more specific than previous curricula with respect to both the knowledge and the skills that students are expected to develop and demonstrate in each grade. The document contains the curriculum expectations for each grade and an achievement chart that describes four levels of student achievement to be used in assessing and evaluating student work.

The present document is part of a set of eight documents – one for each grade – that contain samples ("exemplars") of student work in mathematics at each of the four levels of achievement described in the achievement chart. The exemplar documents are intended to provide assistance to teachers in their assessment of student achievement of the curriculum expectations. The samples represent work produced at the end of the school year in each grade.

Ontario school boards were invited by the Ministry of Education to participate in the development of the exemplars. Teams of teachers and administrators from across the province were involved in developing the assessment materials. They designed the performance tasks and scoring scales ("rubrics") on the basis of selected Ontario curriculum expectations, field-tested them in classrooms, suggested changes, administered the final tasks, marked the student work, and selected the exemplars used in this document. During each stage of the process, external validation teams and Ministry of Education staff reviewed the tasks and rubrics to ensure that they reflected the expectations in the curriculum policy documents and that they were appropriate for all students. External validation teams and ministry staff also reviewed the samples of student work.

The selection of student samples that appears in this document reflects the professional judgement of teachers who participated in the project. No students, teachers, or schools have been identified.

The procedures followed during the development and implementation of this project will serve as a model for boards, schools, and teachers in designing assessment tasks within the context of regular classroom work, developing rubrics, assessing the achievement of their own students, and planning for the improvement of students’ learning.
The samples in this document will provide parents\(^1\) with examples of student work to help them monitor their children's progress. They also provide a basis for communication with teachers.

Use of the exemplar materials will be supported initially through provincial in-service training.

**Purpose of This Document**

This document was developed to:

- show the characteristics of student work at each of the four levels of achievement for Grade 3;
- promote greater consistency in the assessment of student work across the province;
- provide an approach to improving student learning by demonstrating the use of clear criteria applied to student work in response to clearly defined assessment tasks;
- show the connections between what students are expected to learn (the curriculum expectations) and how their work can be assessed using the levels of achievement described in the curriculum policy document for the subject.

Teachers, parents, and students should examine the student samples in this document and consider them along with the information in the Teacher's Notes and Comments/Next Steps sections. They are encouraged to examine the samples in order to develop an understanding of the characteristics of work at each level of achievement and the ways in which the levels of achievement reflect progression in the quality of knowledge and skills demonstrated by the student.

The samples in this document represent examples of student achievement obtained using only one method of assessment, called performance assessment. Teachers will also make use of a variety of other assessment methods and strategies in evaluating student achievement over a school year.

**Features of This Document**

This document contains the following:

- a description of each of three performance tasks (each task focuses on a particular strand or combination of strands), as well as a listing of the curriculum expectations related to the task
- a task-specific assessment chart (“rubric”) for each task
- two samples of student work for each of the four levels of achievement for each task
- Teacher's Notes, which provide some details on the level of achievement for each sample

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1. In this document, *parent(s)* refers to parent(s) and guardian(s).
• Comments/Next Steps, which offer suggestions for improving achievement
• the Teacher Package that was used by teachers in administering each task

It should be noted that each sample for a specific level of achievement represents the characteristics of work at that level of achievement.

The Tasks

The performance tasks were based directly on curriculum expectations selected from The Ontario Curriculum, Grades 1–8: Mathematics, 1997. The tasks encompassed the four categories of knowledge and skills (i.e., problem solving; understanding of concepts; application of mathematical procedures; communication of required knowledge related to concepts, procedures, and problem solving), requiring students to integrate their knowledge and skills in meaningful learning experiences. The tasks gave students an opportunity to demonstrate how well they could use their knowledge and skills in a specific context.

Teachers were required to explain the scoring criteria and descriptions of the levels of achievement (i.e., the information in the task rubric) to the students before they began the assignment.

The Rubrics

In this document, the term rubric refers to a scoring scale that consists of a set of achievement criteria and descriptions of the levels of achievement for a particular task. The scale is used to assess students’ work; this assessment is intended to help students improve their performance level. The rubric identifies key criteria by which students’ work is to be assessed, and it provides descriptions that indicate the degree to which the key criteria have been met. The teacher uses the descriptions of the different levels of achievement given in the rubric to assess student achievement on a particular task.

The rubric for a specific performance task is intended to provide teachers and students with an overview of the expected product with regard to the knowledge and skills being assessed as a whole.

The achievement chart in the curriculum policy document for mathematics provides a standard province-wide tool for teachers to use in assessing and evaluating their students’ achievement over a period of time. While the chart is broad in scope and general in nature, it provides a reference point for all assessment practice and a framework within which to assess and evaluate student achievement. The descriptions associated with each level of achievement serve as a guide for gathering and tracking assessment information, enabling teachers to make consistent judgements about the quality of student work while providing clear and specific feedback to students and parents.
For the purposes of the exemplar project, a single rubric was developed for each performance task. This task-specific rubric was developed in relation to the achievement chart in the curriculum policy document.

The differences between the achievement chart and the task-specific rubric may be summarized as follows:

- The achievement chart contains broad descriptions of achievement. Teachers use it to assess student achievement over time, making a summative evaluation that is based on the total body of evidence gathered through using a variety of assessment methods and strategies.

- The rubric contains criteria and descriptions of achievement that relate to a specific task. The rubric uses some terms that are similar to those in the achievement chart but focuses on aspects of the specific task. Teachers use the rubric to assess student achievement on a single task.

The rubric contains the following components:

- an identification (by number) of the expectations on which student achievement in the task was assessed
- the four categories of knowledge and skills
- the relevant criteria for evaluating performance of the task
- descriptions of student performance at the four levels of achievement (level 3 on the achievement chart is considered to be the provincial standard)

As stated earlier, the focus of performance assessment using a rubric is to improve students' learning. In order to improve their work, students need to be provided with useful feedback. Students find that feedback on the strengths of their achievement and on areas in need of improvement is more helpful when the specific category of knowledge or skills is identified and specific suggestions are provided than when they receive only an overall mark or general comments. Student achievement should be considered in relation to the criteria for assessment stated in the rubric for each category, and feedback should be provided for each category. Through the use of a rubric, students' strengths and weaknesses are identified and this information can then be used as a basis for planning the next steps for learning. In this document, the Teacher's Notes indicate the reasons for assessing a student's performance at a specific level of achievement, and the Comments/Next Steps give suggestions for improvement.

In the exemplar project, a single rubric encompassing the four categories of knowledge and skills was used to provide an effective means of assessing the particular level of student performance in each performance task, to allow for consistent scoring of student performance, and to provide information to students on how to improve their work. However, in the classroom, teachers may find it helpful to make use of additional rubrics if they need to assess student achievement on a specific task in greater detail for one or more of the four categories. For example, it may be desirable in evaluating a written report on an investigation to use separate rubrics for assessing understanding of concepts, problem-solving skills, ability to apply mathematical procedures, and communication skills.
The rubrics for the tasks in the exemplar project are similar to the scales used by the Education Quality and Accountability Office (EQAO) for the Grade 3, Grade 6, and Grade 9 provincial assessments in that both the rubrics and the EQAO scales are based on the Ontario curriculum expectations and the achievement charts. The rubrics differ from the EQAO scales in that they were developed to be used only in the context of classroom instruction to assess achievement in a particular assignment.

Although rubrics were used effectively in this exemplar project to assess responses related to the performance tasks, they are only one way of assessing student achievement. Other means of assessing achievement include observational checklists, tests, marking schemes, or portfolios. Teachers may make use of rubrics to assess students’ achievement on, for example, essays, reports, exhibitions, debates, conferences, interviews, oral presentations, recitals, two- and three-dimensional representations, journals or logs, and research projects.

Development of the Tasks

The performance tasks for the exemplar project were developed by teams of educators in the following way:

- The teams selected a cluster of curriculum expectations that focused on the knowledge and skills that are considered to be of central importance in the subject area. Teams were encouraged to select a manageable number of expectations. The particular selection of expectations ensured that all students would have the opportunity to demonstrate their knowledge and skills in each category of the achievement chart in the curriculum policy document for the subject.

- The teams drafted three tasks for each grade that would encompass all of the selected expectations and that could be used to assess the work of all students.

- The teams established clear, appropriate, and concrete criteria for assessment, and wrote the descriptions for each level of achievement in the task-specific rubric, using the achievement chart for the subject as a guide.

- The teams prepared detailed instructions for both teachers and students participating in the assessment project.

- The tasks were field-tested in classrooms across the province by teachers who had volunteered to participate in the field test. Student work was scored by teams of educators. In addition, classroom teachers, students, and board contacts provided feedback on the task itself and on the instructions that accompanied the task. Suggestions for improvement were taken into consideration in the revision of the tasks, and the feedback helped to finalize the tasks, which were then administered in the spring of 2001.

In developing the tasks, the teams ensured that the resources needed for completing the tasks – that is, all the worksheets and support materials – were available.

Prior to both the field tests and the final administration of the tasks, a team of validators – including research specialists, gender and equity specialists, and subject experts – reviewed the instructions in the teacher and student packages, making further suggestions for improvement.
Assessment and Selection of the Samples

After the final administration of the tasks, student work was scored at the district school board level by teachers of the subject who had been provided with training in the scoring. These teachers evaluated and discussed the student work until they were able to reach a consensus regarding the level to be assigned for achievement in each category. This evaluation was done to ensure that the student work being selected clearly illustrated that level of performance. All of the student samples were then forwarded to the ministry. A team of teachers from across the province, who had been trained by the ministry to assess achievement on the tasks, rescored the student samples. They chose samples of work that demonstrated the same level of achievement in all four categories and then, through consensus, selected the samples that best represented the characteristics of work at each level of achievement. The rubrics were the primary tools used to evaluate student work at both the school board level and the provincial level.

The following points should be noted:

• Two samples of student work are included for each of the four achievement levels. The use of two samples is intended to show that the characteristics of an achievement level can be exemplified in different ways.

• Although the samples of student work in this document were selected to show a level of achievement that was largely consistent in the four categories (i.e., problem solving; understanding of concepts; application of mathematical procedures; communication of required knowledge), teachers using rubrics to assess student work will notice that students’ achievement frequently varies across the categories (e.g., a student may be achieving at level 3 in understanding of concepts but at level 4 in communication of required knowledge).

• Although the student samples show responses to most questions, students achieving at level 1 and level 2 will often omit answers or will provide incomplete responses or incomplete demonstrations.

• Students’ effort was not evaluated. Effort is evaluated separately by teachers as part of the “learning skills” component of the Provincial Report Card.

• The document does not provide any student samples that were assessed using the rubrics and judged to be below level 1. Teachers are expected to work with students whose achievement is below level 1, as well as with their parents, to help the students improve their performance.

Use of the Student Samples

Teachers and Administrators

The samples of student work included in the exemplar documents will help teachers and administrators by:

• providing student samples and criteria for assessment that will enable them to help students improve their achievement;

• providing a basis for conversations among teachers, parents, and students about the criteria used for assessment and evaluation of student achievement;
• facilitating communication with parents regarding the curriculum expectations and levels of achievement for each subject;
• promoting fair and consistent assessment within and across grade levels.

Teachers may choose to:
• use the teaching/learning activities outlined in the performance tasks;
• use the performance tasks and rubrics in the document in designing comparable performance tasks;
• use the samples of student work at each level as reference points when assessing student work;
• use the rubrics to clarify what is expected of the students and to discuss the criteria and standards for high-quality performance;
• review the samples of work with students and discuss how the performances reflect the levels of achievement;
• adapt the language of the rubrics to make it more “student friendly”;
• develop other assessment rubrics with colleagues and students;
• help students describe their own strengths and weaknesses and plan their next steps for learning;
• share student work with colleagues for consensus marking;
• partner with another school to design tasks and rubrics, and to select samples for other performance tasks.

Administrators may choose to:
• encourage and facilitate teacher collaboration regarding standards and assessment;
• provide training to ensure that teachers understand the role of the exemplars in assessment, evaluation, and reporting;
• establish an external reference point for schools in planning student programs and for school improvement;
• facilitate sessions for parents and school councils using this document as a basis for discussion of curriculum expectations, levels of achievement, and standards.

Parents
The performance tasks in this document exemplify a range of meaningful and relevant learning activities related to the curriculum expectations. In addition, this document invites the involvement and support of parents as they work with their children to improve their achievement. Parents may use the samples of student work and the rubrics as:
• resources to help them understand the levels of achievement;
• models to help monitor their children's progress from level to level;
• a basis for communication with teachers about their children's achievement;
• a source of information to help their children monitor achievement and improve their performance;
• models to illustrate the application of the levels of achievement.
Students

Students are asked to participate in performance assessments in all curriculum areas. When students are given clear expectations for learning, clear criteria for assessment, and immediate and helpful feedback, their performance improves. Students’ performance improves as they are encouraged to take responsibility for their own achievement and to reflect on their own progress and “next steps”.

It is anticipated that the contents of this document will help students in the following ways:

• Students will be introduced to a model of one type of task that will be used to assess their learning, and will discover how rubrics can be used to improve their product or performance on an assessment task.

• The performance tasks and the exemplars will help clarify the curriculum expectations for learning.

• The rubrics and the information given in the Teacher’s Notes section will help clarify the assessment criteria.

• The information given under Comments/Next Steps will support the improvement of achievement by focusing attention on two or three suggestions for improvement.

• With an increased awareness of the performance tasks and rubrics, students will be more likely to communicate effectively about their achievement with their teachers and parents, and to ask relevant questions about their own progress.

• Students can use the criteria and the range of student samples to help them see the differences in the levels of achievement. By analysing and discussing these differences, students will gain an understanding of ways in which they can assess their own responses and performances in related assignments and identify the qualities needed to improve their achievement.
Measurement / Patterning and Algebra / Data Management and Probability
Lots of Coins!

The Task
This task required students to:
• investigate the use of coins in different situations;
• explore concepts of measurement, data management, and probability;
• investigate the relationship of weeks to months.

In conducting investigations, students used their knowledge of money, probability, patterning, and time relationships. They solved problems that involved combining given coins; solved probability problems involving coins; and were asked to observe a pattern involving coins and then extend it. Finally, students made a money estimate based on their knowledge of a time relationship. In the various tasks, students explained their thinking and showed their work.

Expectations
This task gave students the opportunity to demonstrate achievement of all or part of each of the following selected expectations from three strands – Measurement, Patterning and Algebra, and Data Management and Probability. Note that the codes that follow the expectations are from the Ministry of Education’s Curriculum Unit Planner (CD-ROM).

Measurement
Students will:
1. demonstrate an understanding of and ability to apply measurement terms: centimetre, metre, kilometre; millilitre, litre; gram, kilogram; degree Celsius; week, month, year (3m34);
2. identify relationships between and among measurement concepts (3m35);
3. solve problems related to their day-to-day environment using measurement and estimation (e.g., in finding the height of the school fence) (3m36);
4. estimate and measure the passage of time in five-minute intervals, and in days, weeks, months, and years (3m44);
5. demonstrate the relationship between all coins and bills up to $100 (3m48);
6. make purchases and change for money amounts up to $10, and estimate, count, and record the value up to $10 of a collection of coins and bills (3m49);
7. read and write money amounts using two forms of notation (89¢ and $0.89) (3m50);
**Patterning and Algebra**

*Students will:*

8. identify, extend, and create linear and non-linear geometric patterns, number and measurement patterns, and patterns in their environment (3m78).

**Data Management and Probability**

*Students will:*

9. collect and organize data (3m91);
10. demonstrate an understanding of probability and demonstrate the ability to apply probability in familiar day-to-day situations (3m93);
11. organize data in Venn diagrams and charts using several criteria (3m100);
12. conduct simple probability experiments (e.g., rolling a number cube, spinning a spinner) and predict the results (3m103);
13. apply the concept of likelihood to events in solving simple problems (3m104);
14. predict the probability that an event will occur (3m105);
15. use mathematical language (e.g., possible, impossible) in discussion to describe probability (3m106).

**Prior Knowledge and Skills**

To complete this task, students were expected to have some knowledge or skills relating to the following:

- applying the concept of likelihood to events in solving problems
- adding and subtracting money amounts and representing the answer in decimal notation
- the relationship between weeks and months

*For information on the process used to prepare students for the task and on the materials and equipment required, see the Teacher Package reproduced on pages 53–58 of this document.*
### Task Rubric – Lots of Coins!

<table>
<thead>
<tr>
<th>Expectations*</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Problem solving</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3, 13, 14</td>
<td>selects and applies a problem-solving strategy to investigate probability and measurement problems, arriving at an incomplete or inaccurate solution</td>
<td>selects and applies an appropriate problem-solving strategy to investigate probability and measurement problems, arriving at a partially complete and/or partially accurate solution</td>
<td>selects and applies an appropriate problem-solving strategy to investigate probability and measurement problems, arriving at a generally complete and accurate solution</td>
<td>selects and applies an appropriate problem-solving strategy to investigate probability and measurement problems, arriving at a thorough and accurate solution</td>
</tr>
<tr>
<td><strong>Understanding of concepts</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4, 6, 9, 10, 11</td>
<td>demonstrates a limited understanding of data management, simple probability, the value of coins, and the relation of weeks to months</td>
<td>demonstrates some understanding of data management, simple probability, the value of coins, and the relation of weeks to months</td>
<td>demonstrates a general understanding of data management, simple probability, the value of coins, and the relation of weeks to months</td>
<td>demonstrates a thorough understanding of data management, simple probability, the value of coins, and the relation of weeks to months</td>
</tr>
<tr>
<td><strong>Application of mathematical procedures</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1, 6, 7, 12</td>
<td>determines a few money amounts and makes an inaccurate or limited connection between weeks and months</td>
<td>determines some money amounts and makes some connection between weeks and months</td>
<td>determines most money amounts and relates weeks to months</td>
<td>determines all money amounts accurately and relates weeks to months clearly and precisely</td>
</tr>
<tr>
<td></td>
<td>applies procedures for determining probability outcomes, combinations and amounts of money, and time relationships, making many errors and/or omissions</td>
<td>applies procedures for determining probability outcomes, combinations and amounts of money, and time relationships, making some errors and/or omissions</td>
<td>applies procedures for determining probability outcomes, combinations and amounts of money, and time relationships, making few errors or omissions</td>
<td>applies procedures for determining probability outcomes, combinations and amounts of money, and time relationships, making few, if any, minor errors or omissions</td>
</tr>
<tr>
<td>Expectations*</td>
<td>Level 1</td>
<td>Level 2</td>
<td>Level 3</td>
<td>Level 4</td>
</tr>
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<td>---------------</td>
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<tr>
<td><strong>Communication of required knowledge</strong></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>The student:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2, 9, 15</td>
<td>- uses symbols, words, charts, pictures, and/or diagrams with limited clarity in describing and illustrating data about money amounts and relationships between units of time</td>
<td>- uses symbols, words, charts, pictures, and/or diagrams with some clarity in describing and illustrating data about money amounts and relationships between units of time</td>
<td>- uses symbols, words, charts, pictures, and/or diagrams clearly in describing and illustrating data about money amounts and relationships between units of time</td>
<td>- uses symbols, words, charts, pictures, and/or diagrams clearly and precisely in describing and illustrating data about money amounts and relationships between units of time</td>
</tr>
<tr>
<td></td>
<td>- uses mathematical language and notation with limited clarity in describing and illustrating probability concepts</td>
<td>- uses mathematical language and notation with some clarity in describing and illustrating probability concepts</td>
<td>- uses mathematical language and notation clearly in describing and illustrating probability concepts</td>
<td>- uses mathematical language and notation clearly and precisely in describing and illustrating probability concepts</td>
</tr>
</tbody>
</table>

*The expectations that correspond to the numbers given in this chart are listed on pages 12–13. Note that, although all of the expectations listed there were addressed through instruction relating to the task, student achievement of expectations 5 and 8 was not assessed in the final product.

*Note:* This rubric does not include criteria for assessing student performance that falls below level 1.
Lots of Coins! Level 1, Sample 1

Exemplar Task

Lots of Coins!

1. Dawson has the following coins.

![coins]

5¢ 10¢ 25¢ $1

a. What are all the possible sums you can get by combining three coins? Present your information in such a way that someone looking at your work will see how you solved the problem.

2. Lo said that you can make $9.56 by combining many of the following coins.

![coins]

5¢ 10¢ 25¢

Do you agree with Lo? Yes [ ] No [x]

Explain why you agree or disagree.

If you add many of the coins you will get $9.56.
3. Imagine that you have these three coins in your pocket:

5¢  10¢  25¢

If you take two coins out of your pocket, what is the probability that you removed 30 cents?
Show your work.

You have 3 coins: nickel, quarter, and a dime. The chances of you getting 30¢ are 1 because there is only one way you can get it: 25¢ nickel and a quarter.

\[ 25\,\text{¢} + 5\,\text{¢} = 30\,\text{¢} \]

4. Make up another probability question using coins.
Show how you would solve the problem.

What is the probability of getting $1.05?

I would say that the probability is \(\frac{1}{3}\) because there is only one way you can get $1.05:

\[ \$1.00 + 10\,\text{¢} = 1.05 \]
5. Here is a pattern using loonies, quarters and dimes.

**Step 1**

- 25¢
- $1
- 25¢
- 10¢

The value of Step 1 is $1.60.

**Step 2**

The value of Step 2 is $2.20.

If this pattern were to continue, what would be the value of Stage 5?

$3.75

Show how you arrived at your answer. Use the back of the sheet if needed.
6. ESTIMATE how much money you would have, if you were given $0.55 each week, and you saved the money for three months.

My estimate is: $165.00

Show how you estimated your answer.
Organize your work here, and explain your thinking.

1 week = $0.55
3 months = $165.00
5 weeks in a month.

Teacher’s Notes
Problem Solving
- The student selects and applies a problem-solving strategy to investigate probability and measurement problems, arriving at an incomplete or inaccurate solution (e.g., in question 1, uses a diagram to show combinations, many of which are incorrect; in question 3, poses an incomplete probability question).

Understanding of Concepts
- The student demonstrates a limited understanding of data management, simple probability, the value of coins, and the relation of weeks to months (e.g., in question 1, uses incorrect coin values in making a pictorial list of possible solutions; in question 3, states that “the changes [chances] of you get 30¢ are 1 because there is only one way you can get it 30¢ it is a nickel and a qarter”).

Application of Mathematical Procedures
- The student determines a few money amounts (e.g., in question 1) and makes an inaccurate or limited connection between weeks and months (e.g., in question 6, “5 weeks in a month”).
- The student applies procedures for determining probability outcomes, combinations and amounts of money, and time relationships, making many errors and/or omissions (e.g., in question 6, estimates that 1 week = 55¢, and 3 months x 55¢ = $165.00).

Communication of Required Knowledge
- The student uses symbols, words, charts, pictures and/or diagrams with limited clarity in describing and illustrating data about money amounts and relationships between units of time (e.g., in question 5, gives diagrams of steps 3 to 5, but calculates the value of step 5 incorrectly).
- The student uses mathematical language and notation with limited clarity in describing and illustrating probability concepts (e.g., in question 4, the instructions for the probability question that the student makes up are unclear because they are incomplete: “What is the probability of you getting $1.05. Show your work”).
Comments/Next Steps
- The student should continue to work with concrete materials (e.g., coins, a calendar) to confirm solutions to tasks.
- The student needs to use clear mathematical language, notation, charts, and pictures to communicate his or her findings clearly.
- The student needs to use a chart or table when exploring problems involving probability.
- The student should refer to word charts or a personal dictionary for correct spellings.
Lots of Coins!
Level 1, Sample 2

Exemplar Task

Lots of Coins!

1. Dawson has the following coins.

5¢  10¢  25¢  $1

a. What are all the possible sums you can get by combining three coins? Present your information in such a way that someone looking at your work will see how you solved the problem.

\[
\begin{align*}
5\,\text{¢} + 10\,\text{¢} + 25\,\text{¢} &= 40\,\text{¢} \\
25\,\text{¢} + 10\,\text{¢} + 5\,\text{¢} &= 40\,\text{¢} \\
10\,\text{¢} + 25\,\text{¢} + 5\,\text{¢} &= 40\,\text{¢} \\
1.00 + 25\,\text{¢} + 10\,\text{¢} &= 1.35 \text{ or } \$1.35 \\
10\,\text{¢} + 25\,\text{¢} + 1.00 &= 1.35 \text{ or } \$1.35
\end{align*}
\]

2. Lo said that you can make $9.56 by combining many of the following coins.

5¢  10¢  25¢

Do you agree with Lo? Yes ☐ No ☒

Explain why you agree or disagree.

I do not agree because when I used my calculator it went up to 9.55 not 9.56.
3. Imagine that you have these three coins in your pocket:

![Coins](image)

If you take two coins out of your pocket, what is the probability that you removed 30 cents? Show your work.

- You can get 30¢ if you take 5¢ coin and 25¢ coin, but if you take 10¢ and 5¢ you get 15¢ or you pull out 10 and 25¢, you get 35¢. So the right answer is 5 and 25¢ 1 out of 3

4. Make up another probability question using coins.

Show how you would solve the problem.

- If you had 41¢ in pot and you only had these coins: 5¢ 10¢ 25¢ 1¢, can you have 41¢ in the pot? Yes [ ] No [X]

Because if you add them all together you get 41¢
5. Here is a pattern using loonies, quarters and dimes.

**Step 1**
- 25¢
- $1
- 25¢
- 10¢

**Step 2**

The value of Step 1 is $1.60.
The value of Step 2 is $2.20.

If this pattern were to continue, what would be the value of Stage 5?

Show how you arrived at your answer. Use the back of the sheet if needed.
6. ESTIMATE how much money you would have, if you were given $0.55 each week, and you saved the money for three months.

My estimate is: 5.50

Show how you estimated your answer.

Organize your work here, and explain your thinking.

I used my calculator and added 55, 12 times, and my answer came to 5.50. But if one month had 3 weeks the other would have 4.95, but if the months had 2 months they would have 4.45, but if all the months had 3 weeks he would have 3.85, so there are 4 answers.

Teacher’s Notes

Problem Solving
- The student selects and applies a problem-solving strategy to investigate probability and measurement problems, arriving at an incomplete or inaccurate solution (e.g., in question 1, uses pictures to show two possible solutions, which are repeated several times; in question 3, presents an answer that gives coin combinations but does not address probability clearly).

Understanding of Concepts
- The student demonstrates a limited understanding of data management, simple probability, the value of coins, and the relation of weeks to months (e.g., in question 1, gives an incomplete list of possible coin combinations and repeats solutions; in question 4, makes up an addition question rather than a probability question).

Application of Mathematical Procedures
- The student determines a few money amounts and makes an inaccurate or limited connection between weeks and months (e.g., in question 6, miscalculates 12 x 55 and suggests the possibility of a three-week month: “I used my calculator and added 55, 12 times, and my answer came to 5.50, but if one month [month] had 3 weeks he would have 495”).
- The student applies procedures for determining probability outcomes, combinations and amounts of money, and time relationships, making many errors and/or omissions (e.g., in question 5).

Communication of Required Knowledge
- The student uses symbols, words, charts, pictures, and/or diagrams with limited clarity in describing and illustrating data about money amounts and relationships between units of time (e.g., in question 5, steps 3 to 5 are recorded but two amounts in the steps are added incorrectly).
- The student uses mathematical language and notation with limited clarity in describing and illustrating probability concepts (e.g., in question 3, the labelled illustration of 5 plus 25 to show 30¢ and the written explanation have limited connection to the probability question posed).
Comments/Next Steps

– The student should continue to work with concrete materials (e.g., coins, a calendar) to explore probability and time.
– The student needs to use clear mathematical language, notation, charts, and pictures to communicate his or her findings clearly.
– The student should refer to word charts or a personal dictionary for correct spellings.
Exemplar Task

Lots of Coins!

1. Dawson has the following coins.

a. What are all the possible sums you can get by combining three coins? Present your information in such a way that someone looking at your work will see how you solved the problem.

\[ 5\,\text{c} + 10\,\text{c} + 25\,\text{c} = 40\,\text{c} \]
\[ 10\,\text{c} + 0\,\text{c} + 10\,\text{c} = 30\,\text{c} \]
\[ 0\,\text{c} + 25\,\text{c} + 1\,\text{c} = 1.35 \]
\[ 10\,\text{c} + 5\,\text{c} + 1\,\text{c} = 1.15 \]
\[ 25\,\text{c} + 1\,\text{c} + 10\,\text{c} = 36.10 \]

2. Lo said that you can make $9.56 by combining many of the following coins.

\[ 5\,\text{c} \quad 10\,\text{c} \quad 25\,\text{c} \]

Do you agree with Lo? Yes ☐ No ☐

Explain why you agree or disagree.

I disagree with Lo.
Because you can’t make a six with the coins chosen.
3. Imagine that you have these three coins in your pocket:

5¢  10¢  25¢

If you take two coins out of your pocket, what is the probability that you removed 30 cents?
Show your work.

The chance that you would get to pull out 30¢ would be 1 out of three.

4. Make up another probability question using coins.
Show how you would solve the problem.

If you had these coins in a bag, what are the chances to pull out the two dollar coin?
5. Here is a pattern using loonies, quarters and dimes.

**Step 1**
- 25¢
- 25¢
- $1

**Step 2**
- 10¢

The value of Step 1 is $1.60. The value of Step 2 is $2.20.

If this pattern were to continue, what would be the value of Stage 5?

Show how you arrived at your answer. Use the back of the sheet if needed.
6. ESTIMATE how much money you would have, if you were given $0.55 each week, and you saved the money for three months.

My estimate is: $6.00

Show how you estimated your answer.

Organize your work here, and explain your thinking.

[Diagram showing different combinations of weeks and amounts of money saved]

Teacher’s Notes

Problem Solving
- The student selects and applies an appropriate problem-solving strategy to investigate probability and measurement problems, arriving at a partially complete and/or partially accurate solution (e.g., in question 1, identifies three of the possible combinations and creates additional combinations by using the same coin more than once; in question 3, gives a statement but does not show his or her work).

Understanding of Concepts
- The student demonstrates some understanding of data management, simple probability, the value of coins, and the relation of weeks to months (e.g., in question 3, expresses probability as a number: “1 out of three”).

Application of Mathematical Procedures
- The student determines some money amounts and makes some connection between weeks and months (e.g., in question 6, makes a reasonable estimate of the amount saved, draws four weeks for each month, but miscalculates the amount saved).
- The student applies procedures for determining probability outcomes, combinations and amounts of money, and time relationships, making some errors and/or omissions (e.g., in question 4, creates a probability question but omits a solution).

Communication of Required Knowledge
- The student uses symbols, words, charts, pictures, and/or diagrams with some clarity in describing and illustrating data about money amounts and relationships between units of time (e.g., in question 2, communicates his or her explanation with some clarity, “I disagree with Lo Because you can’t make a six with the coins choosen”).
- The student uses mathematical language and notation with some clarity in describing and illustrating probability concepts (e.g., in question 4, asks, “What are the chances to pull out the two dollar coin?” but does not state how many coins will be pulled out of the bag at a time).
Comments/Next Steps

- The student should develop a broader vocabulary for discussing probability (e.g., likely, unlikely, probably, possible, impossible).
- The student needs to use charts, diagrams, numbers, and appropriate mathematical language to express solutions.
- The student needs to use dollar notation where appropriate.
**Exemplar Task**

**Lots of Coins!**

1. Dawson has the following coins.

   ![Coins Image]

   - 5¢
   - 10¢
   - 25¢
   - $1

   a. What are all the possible sums you can get by combining three coins? Present your information in such a way that someone looking at your work will see how you solved the problem.

   \[
   5 + 10 + 25 = 40 \\
   5 + 25 + 10 = 40 \\
   10 + 5 + 25 = 40 \\
   25 + 10 + 5 = 40
   \]

   It was really easy because I now my math really well.

2. Lo said that you can make $9.56 by combining many of the following coins.

   ![Coin Image]

   - 5¢
   - 10¢
   - 25¢

   Do you agree with Lo? Yes [ ] No [X]

   Explain why you agree or disagree.

   \[
   \text{now lets won't get } \text{9.56} \text{ by combining } 9.00 + 9.00 = 18.00 \\
   \text{combining } 5 + 25 + 25 = 50 \\
   9.50 + 5 \text{ I can't get 56 but I can get } 9.50 + 55 \text{ (an error)}
   \]
3. Imagine that you have these three coins in your pocket:

5¢  10¢  25¢

If you take two coins out of your pocket, what is the probability that you removed 30 cents?

Show your work.

\[
\begin{align*}
5 + 10 &= 15 \\
10 + 25 &= 35 \\
25 + 5 &= 30 \\
5 + 25 &= 30 \\
10 + 25 &= 35 \\
25 + 10 &= 35
\end{align*}
\]

I probability of getting 30¢ is 2 out of 6

4. Make up another probability question using coins.

Show how you would solve the problem.

\[
\begin{align*}
1.00 + 10 &= 1.10 \\
1.00 + 10 &= 1.10 \\
1.00 + 1.00 &= 1.01 \\
1.00 + 10 &= 1.10 \\
1.00 + 1.00 &= 1.11 \\
1.00 + 1.00 &= 1.11
\end{align*}
\]
5. Here is a pattern using loonies, quarters and dimes.

Step 1

25¢  $1  25¢

Step 2

10¢

The value of Step 1 is $1.60.
The value of Step 2 is $2.20.

If this pattern were to continue, what would be the value of Stage 5?

Show how you arrived at your answer. Use the back of the sheet if needed.

5. ESTIMATE how much money you would have, if you were given $0.55 each week, and you saved the money for three months.

My estimate is: 

5.60

Show how you estimated your answer.

Organize your work here, and explain your thinking.

I used my calculator and the result is 6.00
Teacher’s Notes

Problem Solving
- The student selects and applies an appropriate problem-solving strategy to investigate probability and measurement problems, arriving at a partially complete and/or partially accurate solution (e.g., in question 1, finds all the solutions but omits the appropriate notations [e.g., $1.35]; in question 3, repeats each result twice, so finds a probability of 2 out of 6 rather than 1 out of 3).

Understanding of Concepts
- The student demonstrates some understanding of data management, simple probability, the value of coins, and the relation of weeks to months (e.g., in question 2, recognizes that he or she “can’t get 56” but “can get 55”, without stating the need for a penny; in question 4, uses the model of question 3; in question 6, calculates on the assumption that there are four weeks in a month).

Application of Mathematical Procedures
- The student determines some money amounts and makes some connection between weeks and months (e.g., in question 2, states, “I can’t get 56 but I can get 55”; in question 6, does not make an explicit connection between weeks and months but finds the correct amount of savings for three months).
- The student applies procedures for determining probability outcomes, combinations and amounts of money, and time relationships, making some errors and/or omissions (e.g., in question 1, makes a list of possible solutions; in question 3, records probability solutions twice, so that the results are “2 out of 6”).

Communication of Required Knowledge
- The student uses symbols, words, charts, pictures, and/or diagrams with some clarity in describing and illustrating data about money amounts and relationships between units of time (e.g., the diagram in question 2 is inaccurate, but the student’s conclusion is correct).
- The student uses mathematical language and notation with some clarity in describing and illustrating probability concepts (e.g., in question 4, poses a question [“what is the probability of teacking out 11¢”] and gives possible number combinations, but omits a summary statement).

Comments/Next Steps
- The student should use charts or diagrams to assist in solving various problems.
- The student should develop a broader vocabulary for discussing probability (e.g., likely, unlikely, possible, impossible)
- The student needs to communicate more clearly by recording work more completely when solving problems.
- The student needs to use dollar notation where appropriate.
- The student should refer to word charts or a personal dictionary for correct spellings.
Lots of Coins!  Level 3, Sample 1

Exemplar Task

Lots of Coins!

1. Dawson has the following coins.

5¢  10¢  25¢  $1

a. What are all the possible sums you can get by combining three coins? Present your information in such a way that someone looking at your work will see how you solved the problem.

<table>
<thead>
<tr>
<th>100¢</th>
<th>25¢</th>
<th>10¢</th>
<th>5¢</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$1.35</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
<td>$1.15</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>1</td>
<td>1</td>
<td>$1.30</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
<td>$1.25</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>$1.30</td>
</tr>
</tbody>
</table>

What is the answer? The answers are $1.30, 40¢, 11.15, $1.30 and these are the answers.

Why is it the answer? It is the answer because you can only use 3 coins at a time and I looked how many ways there is and there is 4 answers.

How did you get the answer? I made a money chart and it looks like this.

<table>
<thead>
<tr>
<th>100¢</th>
<th>25¢</th>
<th>10¢</th>
<th>5¢</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$1.35</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td>$1.25</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>1</td>
<td>1</td>
<td>$1.30</td>
</tr>
</tbody>
</table>
2. Lo said that you can make $9.56 by combining many of the following coins.

![Coins: 5¢, 10¢, 25¢]

Do you agree with Lo? Yes [ ] No [x] 

Explain why you agree or disagree.

You can make $9.00 but you can't make $9.56 but you can make 55¢ so if you want to make 56¢ then you need a penny because that's the only way you can make $9.00 plus you need 2 quarters. Nickel and 1 penny and he has no pennies so he can't make $9.56 but you can make 55¢ and that's the closest you can get to it.

3. Imagine that you have these three coins in your pocket:

![Coins: 5¢, 10¢, 25¢]

If you take two coins out of your pocket, what is the probability that you removed 30 cents?

Show your work.

There is 1/3 chances of making 30¢ because it only works one way and that way is 5¢ + 15¢ = 30¢ and 5¢ + 10¢ = 15¢ and that's not the answer and there is one more combination it is 25¢ + 5¢ = 30¢ that doesn't make the answer so it must be the only one so now you know that there is 1/3 chances of making 30¢.
What is the answer?
The answer is \( \frac{5}{15} = \frac{1}{3} \) and there is \( \frac{1}{3} \) chances.

Why is the answer?
It is the answer because I tried all the answers
and this is the one I picked \( \frac{5}{15} = \frac{1}{3} \), that's why
it's the answer.

How did you get the answer?
I got the answer from trying every way
to make \( \frac{1}{3} \) and I told what the
probability would be in writing.

4. Make up another probability question using coins.
Show how you would solve the problem.

Say you had these 4 coins:

\[ \text{\$1} \quad \text{\$0.25} \quad \text{\$0.10} \quad \text{\$0.05} \]

If you take three coins out of your pocket.
What is the probability that you removed
\$1.30?
There is \( \frac{1}{4} \) chance of making \$1.30
because it only works one way.
And that way is \( \text{\$0.25} + \text{\$0.10} + \text{\$0.05} \),
because there is only those coins
to make \$1.30 and if you wanted
to make it a different way
you would need more coins.
5. Here is a pattern using loonies, quarters and dimes.

![Pattern Diagram]

Step 1
- 25¢
- $1
- 25¢
- 10¢

The value of Step 1 is $1.60.

Step 2

The value of Step 2 is $2.20.

If this pattern were to continue, what would be the value of Stage 5?

Show how you arrived at your answer. Use the back of the sheet if needed.

6. ESTIMATE how much money you would have, if you were given $0.55 each week, and you saved the money for three months.

My estimate is: $6.00

Show how you estimated your answer.

Organize your work here, and explain your thinking.

<table>
<thead>
<tr>
<th>1 month</th>
<th>2 month</th>
<th>3 month</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>$2.00</td>
<td>$2.00</td>
<td>$2.00</td>
<td>$6.00</td>
</tr>
</tbody>
</table>

The estimate is $6.00 because $2.00 for three months = $6.00
**Teacher’s Notes**

**Problem Solving**
- The student selects and applies an appropriate problem-solving strategy to investigate probability and measurement problems, arriving at a generally complete and accurate solution (e.g., draws a chart to systematically solve the problem in question 1; lists all of the possibilities in question 3).

**Understanding of Concepts**
- The student demonstrates a general understanding of data management, simple probability, the value of coins, and the relation of weeks to months (e.g., lists all of the possible coin combinations to determine the probability in question 3).

**Application of Mathematical Procedures**
- The student determines most money amounts and relates weeks to months (e.g., recognizes that a penny is needed to make $9.56 in question 2; estimates savings of $2.00 for one month, providing evidence of accuracy in relating weeks to months in question 6).
- The student applies procedures for determining probability outcomes, combinations and amounts of money, and time relationships, making few errors or omissions (e.g., in question 1, uses an effective strategy, a chart, to determine the possible combinations of coins; in question 5, is able to skip to step 5 to find the correct solution).

**Communication of Required Knowledge**
- The student uses symbols, words, charts, pictures, and/or diagrams clearly in describing and illustrating data about money amounts and relationships between units of time (e.g., uses a diagram to accurately represent the fifth stage in the coin pattern in question 5.)
- The student uses mathematical language and notation clearly in describing and illustrating probability concepts (e.g., in question 3, states that “25¢ and 5¢ = 30¢” and adds, “there is ½ chances of making 30¢”).

**Comments/Next Steps**
- The student needs to use dollar notation where appropriate.
- The student should continue to communicate his or her ideas by using charts, diagrams, or words.
- The student should check all calculations carefully.
Lots of Coins!   Level 3, Sample 2

Exemplar Task

Lots of Coins!

1. Dawson has the following coins.

![Coins Image]

b. What are all the possible sums you can get by combining three coins? Present your information in such a way that someone looking at your work will see how you solved the problem.

![Sums Image]

2. Lo said that you can make $9.56 by combining many of the following coins.

![Coins Image]

Do you agree with Lo?  Yes  No

Explain why you agree or disagree.

You can't because you don't have a penny.

4 - 25¢ = $1.00
5 - 10¢ = 50¢
1 - 5¢ = 5¢

$1.55
3. Imagine that you have these three coins in your pocket:

$$5\epsilon \quad 10\epsilon \quad 25\epsilon$$

If you take two coins out of your pocket, what is the probability that you removed 30 cents?
Show your work.

\[
\frac{1}{3} \text{ or } \frac{1}{3} \\
30\% \text{ If you pull out a } 5\epsilon \text{ and a } 25\epsilon \text{ coins to get}
\text{You would get } 35\epsilon. \text{ You can also pull out a}
10\epsilon \text{ and a } 5\epsilon \text{ coin. You would get: } 15\epsilon
\]

4. Make up another probability question using coins.
Show how you would solve the problem.

If you took out 1 coin what is the probability of getting $1.00?

\[
\frac{1}{3} \text{ or } \frac{1}{3}
\]

Pull out a dime = 10\epsilon.
Pull out a quarter = 25\epsilon.
Pull out a dollar = $1.00.
5. Here is a pattern using loonies, quarters and dimes.

**Step 1**

- 25¢
- $1
- 25¢
- 25¢
- 10¢
- $0.60

**Step 2**

- 25¢
- 25¢
- 25¢
- 25¢
- $2.20

The value of Step 1 is $1.60. The value of Step 2 is $2.20.

If this pattern were to continue, what would be the value of Stage 5? $4.00

Show how you arrived at your answer. Use the back of the sheet if needed.
6. **ESTIMATE** how much money you would have, if you were given $0.55 each week, and you saved the money for three months.

My estimate is: $6.50

Show how you estimated your answer.

Organize your work here, and explain your thinking.

\[
\begin{align*}
1 \text{ month} &= 4 \text{ weeks} \\
2 \text{ months} &= 8 \text{ weeks} \\
3 \text{ months} &= 12 \text{ weeks} \\
120 \text{ days} &= 3 \text{ months} \\
&= 3 \times 5 \text{ weeks} \\
&= 15 \text{ weeks} \\
6.60
\end{align*}
\]

**Teacher’s Notes**

**Problem Solving**
- The student selects and applies an appropriate problem-solving strategy to investigate probability and measurement problems, arriving at a generally complete and accurate solution (e.g., in question 1, lists all the possibilities to arrive at a complete solution; in question 5, applies a patterning strategy to solve the problem).

**Understanding of Concepts**
- The student demonstrates a general understanding of data management, simple probability, the value of coins, and the relation of weeks to months (e.g., in question 1, accurately determines the combinations and sums of coins; in question 3, lists all the combinations to determine the probability).

**Application of Mathematical Procedures**
- The student determines most money amounts and relates weeks to months (e.g., in question 6, accurately relates 4 weeks to 1 month).
- The student applies procedures for determining probability outcomes, combinations and amounts of money, and time relationships, making few errors or omissions (e.g., in question 5, adds dollar and cent amounts and records the amounts appropriately; in question 2, recognizes that a penny is needed).

**Communication of Required Knowledge**
- The student uses symbols, words, charts, pictures, and/or diagrams clearly in describing and illustrating data about money amounts and relationships between units of time (e.g., in question 5, draws steps 3, 4, and 5 and records the sum of each stage; in question 6, uses symbols to relate weeks to months).
- The student uses mathematical language and notation clearly in describing and illustrating probability concepts (e.g., in question 3, expresses the probability appropriately as \(\frac{1}{3}\); in question 4, explains how to determine the probability by taking one coin at a time).
Comments/Next Steps
- The student should identify and apply estimation strategies (e.g., rounding, using compatible numbers).
- The student should develop a broader vocabulary for discussing probability (e.g., chance, likely, unlikely, possible, impossible).
Lots of Coins! Level 4, Sample 1

Exemplar Task

Lots of Coins!

1. Dawson has the following coins.

![Image of coins: 5¢, 10¢, 25¢, $1]

a. What are all the possible sums you can get by combining three coins? Present your information in such a way that someone looking at your work will see how you solved the problem.

\[
\begin{align*}
5¢ & \quad 10¢ & \quad 25¢ & \quad 5¢ \\
10¢ & \quad 25¢ & \quad 25¢ & \quad 10¢ \\
25¢ & \quad 1.00 & \quad + & \quad 1.00 & \quad + & \quad 1.00 \\
+25¢ & \quad 1.35 & \quad + & \quad 1.30 & \quad + & \quad 1.15 \\
40¢ & \quad 1.35 & \quad 1.30 & \quad 1.15.
\end{align*}
\]

Find my answers by always covering up one coin so that I had three other coins showing and you have to do 3 coin combinations. But I never covered up the same coin twice. So my answers are:

\[
40¢, 1.35, 1.30, 1.15.
\]

2. Lo said that you can make $9.56 by combining many of the following coins.

![Image of coins: 5¢, 10¢, 25¢]

Do you agree with Lo? No

Explain why you agree or disagree.

You cannot use those coins to make $9.56 because you would need a penny. If Lo's answer was 1¢ less or 1¢ more you could but for $9.56 you would need a penny. e.g.

\[
\begin{align*}
25¢ & \quad \times \quad 3 \\
\equiv & \quad \equiv
\end{align*}
\]

I used it - times
3. Imagine that you have these three coins in your pocket:

If you take two coins out of your pocket, what is the probability that you removed 30 cents?
Show your work.

\[
\frac{1}{3} \text{ That is the probability that I'll pull out 30¢ and I'd also have around a 3.3% chance that I'd pull out 30¢.}
\]

1. \(25¢ + 5¢ = 30¢\) *I want 30¢, so

2. \(5¢ + 0¢ = 15¢\) that's a \(\frac{1}{2}\) chance I'm going to get it.

3. \(25¢ + 0¢ = 35¢\)

4. Make up another probability question using coins.

Show how you would solve the problem.

You have 4 cups. I have a looney under it. If you close your eyes and somebody scrambles the cups up, how probable is it you would pick the cup with the looney under it?

\[
\frac{1}{4} \text{ That is the probability that you would pick the cup with the coin under it. We say this because you have a } \frac{1}{4} (25\%) \text{ chance that you'll pick the money cup, because you have a } \frac{3}{4} (75\%) \text{ chance that you'll get a cup without money in it.}
\]
5. Here is a pattern using loonies, quarters and dimes.

**Step 1**
- 25¢
- $1
- 25¢

**Step 2**
- $4.00
- 10¢

The value of Step 1 is $1.60.
The value of Step 2 is $2.20.

If this pattern were to continue, what would be the value of Stage 5?

My estimate is: $4.00

Show how you arrived at your answer. Use the back of the sheet if needed.

I got my answer by multiplying 10 x 5, and the answer was 50. Then I typed in $ in my calculator and put 25 x 2 x 5 = and it said $2.50 then I put + (0) 100 = and it said $4.00. Then I added the decimal point and the dollar sign and then the answer was $4.00.

6. ESTIMATE how much money you would have, if you were given $0.55 each week, and you saved the money for three months.

My estimate is: $6.60

Show how you estimated your answer.

Organize your work here, and explain your thinking.

55 x $0.55 = I thought, because you get 55 cents for 3 months and there are 4 weeks in a month. So 55(cents) x 4(weeks in each of the 3 months). Then I came to an estimate that it is a bit more than $6.50 and around a half a dollar less than $7.00.
**Teacher’s Notes**

**Problem Solving**
- The student selects and applies an appropriate problem-solving strategy to investigate probability and measurement problems, arriving at a thorough and accurate solution (e.g., in question 4, effectively illustrates and explains a probability situation; in question 5, applies a patterning strategy in using a calculator to solve the problem).

**Understanding of Concepts**
- The student demonstrates a thorough understanding of data management, simple probability, the value of coins, and the relation of weeks to months (e.g., recognizes in question 3 that 1/3 probability is 33.3%; creates an original probability problem in question 4 and describes the probability in two situations).

**Application of Mathematical Procedures**
- The student determines all money amounts accurately and relates weeks to months clearly and precisely (e.g., understands the number of coins at step 5 of the pattern in question 5).
- The student applies procedures for determining probability outcomes, combinations and amounts of money, and time relationships, making few, if any, minor errors or omissions (e.g., in question 5, solves the problem in smaller steps by calculating the value of dimes [10 x 5], quarters [25 x 2 x 5], and loonies [$1], and then totalling these values).

**Communication of Required Knowledge**
- The student uses symbols, words, charts, pictures, and/or diagrams clearly and precisely in describing and illustrating data about money amounts and relationships between units of time (e.g., in question 2, supports his or her statement that a penny is needed by considering other options: “If Lo’s answer was 1¢ less or 4¢ more you could but for $9.56 you would need a penny”; in question 6, describes his or her thinking: “55 x 4 x 3 I thought, because you get 55¢ for 3 months and there are 4 weeks in a month”).

- The student uses mathematical language and notation clearly and precisely in describing and illustrating probability concepts (e.g., in questions 3 and 4, expresses probability in more than one way, both as a number from 1 to 0 [e.g., 1/3] and as a percentage; in question 4, uses appropriate mathematical language such as “chance” and “How probable is it …” to describe probability).

**Comments/Next Steps**
- The student needs to use dollar notation where appropriate.
- The student should continue to use words, charts, and diagrams to express findings.
- The student should check all calculations carefully.
Exemplar Task

Lots of Coins!

1. Dawson has the following coins.

5¢  10¢  25¢  $1

a. What are all the possible sums you can get by combining three coins? Present your information in such a way that someone looking at your work will see how you solved the problem.

\[
\begin{align*}
40¢ & \quad 1.00 \\
25¢ & \quad + 0.10 \\
20¢ & \quad + 0.05 \\
10¢ & \quad + 0.25 \\
\hline
40¢ & \quad 1.35 \\
25¢ & \quad 1.15 \\
20¢ & \quad 1.30
\end{align*}
\]

2. Lo said that you can make $9.56 by combining many of the following coins.

5¢  10¢  25¢

Do you agree with Lo? Yes ☐ No ☑

Explain why you agree or disagree.

I disagree because you can make $9.56 but you cannot make $9.56 because there are no pennies. I know this because if you add 5¢, 10¢, and 25¢ the last number is always 5.
3. Imagine that you have these three coins in your pocket:

| 5¢ | 10¢ | 25¢ |

If you take two coins out of your pocket, what is the probability that you removed 30 cents?
Show your work. The probability is that your chance of pulling out 2 coins and getting 30 cents is 1 out of 3. You could pull out a quarter and a dime, a dime and a nickel and a quarter and a nickel.

4. Make up another probability question using coins.
Show how you would solve the problem.

If you had 4 coins in your pocket what is the probability of pulling out the loonie and the quarter?

The probability of pulling out the loonie and the quarter is 1/6. You could pull out the quarter and the dime, the quarter and the nickel, the dime and the nickel, the loonie and the dime, the loonie and the nickel, and the loonie and the quarter.
5. Here is a pattern using loonies, quarters and dimes.

Step 1

25¢ $1 25¢ 10¢

The value of Step 1 is $1.60.

Step 2

The value of Step 2 is $2.20.

If this pattern were to continue, what would be the value of Stage 5? The value of stage 5 would be $4.00.

Show how you arrived at your answer. Use the back of the sheet if needed.

6. ESTIMATE how much money you would have, if you were given $0.55 each week, and you saved the money for three months.

My estimate is: $6.00

Show how you estimated your answer.

Organize your work here, and explain your thinking.

I think it is $6.00 because I know that there are 4 weeks in a month and that the money that you would get is roughly $2.00 so if you add $2.00 + $2.00 + $2.00 = $6.00 so $6.00 is my estimate.

<table>
<thead>
<tr>
<th>Month</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>15</td>
<td>20</td>
<td>17</td>
<td>18</td>
<td>20</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>22</td>
<td>25</td>
<td>24</td>
<td>25</td>
<td>28</td>
<td>27</td>
<td>29</td>
</tr>
</tbody>
</table>
Teacher’s Notes

Problem Solving
- The student selects and applies an appropriate problem-solving strategy to investigate probability and measurement problems, arriving at a thorough and accurate solution (e.g., in question 1, systematically displays all the possible combinations and sums; in question 5, uses drawings to apply a patterning strategy in solving the problem.)

Understanding of Concepts
- The student demonstrates a thorough understanding of data management, simple probability, the value of coins, and the relation of weeks to months (e.g., finds all the possible solutions in question 1; illustrates the probability “1 out of 3” in question 3).

Application of Mathematical Procedures
- The student determines all money amounts accurately and relates weeks to months clearly and precisely (e.g., in question 2, provides a thorough explanation of the need for a penny; in question 6, relates 4 weeks to a month).
- The student applies procedures for determining probability outcomes, combinations and amounts of money, and time relationships, making few, if any, minor errors or omissions (e.g., in question 5, accurately calculates the values of dimes, quarters, and loonies, and then adds these values together; clearly understands dollar notation).

Communication of Required Knowledge
- The student uses symbols, words, charts, pictures, and/or diagrams clearly and precisely in describing and illustrating data about money amounts and relationships between units of time (e.g., in question 6, uses a drawing of a calendar, symbols, and words to communicate the estimation strategy clearly and precisely).
- The student uses mathematical language and notation clearly and precisely in describing and illustrating probability concepts (e.g., in question 4, clearly describes an appropriate probability problem).

Comments/Next Steps
- The student should use mathematical language (e.g., possible, impossible, likely, unlikely) to describe probability.
- The student should continue to use charts and diagrams as well as words to record solutions.
Teacher Package

Mathematics Exemplar Task
Grade 3 – Measurement, Patterning and Algebra, and Data Management and Probability

**Teacher Package**

**Title:** Lots of Coins!

**Time Requirements:** 200 minutes (total)
- 40 minutes to complete Pre-task 1
- 20 minutes to complete Pre-task 2
- 20 minutes to complete Pre-task 3
- 40 minutes to complete questions 1 and 2
- 40 minutes to complete questions 3 and 4
- 40 minutes to complete questions 5 and 6

**Description of the Task**

This task will require students to:
- investigate the use of coins in different situations;
- explore concepts of measurement, data management, and probability;
- investigate the relationship of weeks to months.

In conducting investigations, students will use their knowledge of money, probability, patterning, and time relationships. They will solve problems that involve combining given coins; solve probability problems involving coins; and be asked to observe a pattern involving coins and then extend it. Finally, students will make a money estimate based on their knowledge of a time relationship. In the various tasks, students will explain their thinking and show their work.

**Expectations Addressed in the Exemplar Task**

Note that the codes that follow the expectations are from the Ministry of Education's *Curriculum Unit Planner* (CD-ROM).

**Measurement**

*Students will:*
1. demonstrate an understanding of and ability to apply measurement terms: centimetre, metre, kilometre; millilitre, litre; gram, kilogram; degree Celsius; week, month, year (3m34);
2. identify relationships between and among measurement concepts (3m35);
3. solve problems related to their day-to-day environment using measurement and estimation (e.g., in finding the height of the school fence) (3m36);
4. estimate and measure the passage of time in five-minute intervals, and in days, weeks, months, and years (3m44);
5. demonstrate the relationship between all coins and bills up to $100 (3m48);
6. make purchases and change for money amounts up to $10, and estimate, count, and record the value up to $10 of a collection of coins and bills (3m49);
7. read and write money amounts using two forms of notation (89¢ and $0.89) (3m50).

**Patterning and Algebra**

*Students will:*
8. identify, extend, and create linear and non-linear geometric patterns, number and measurement patterns, and patterns in their environment (3m78).

**Data Management and Probability**

*Students will:*
9. collect and organize data (3m91);
10. demonstrate an understanding of probability and demonstrate the ability to apply probability in familiar day-to-day situations (3m93);
11. organize data in Venn diagrams and charts using several criteria (3m100);
12. conduct simple probability experiments (e.g., rolling a number cube, spinning a spinner) and predict the results (3m103);
13. apply the concept of likelihood to events in solving simple problems (3m104);
14. predict the probability that an event will occur (3m105);
15. use mathematical language (e.g., possible, impossible) in discussion to describe probability (3m106).
Note that, although all of the expectations listed will be addressed through instruction relating to the task, student achievement of expectations 5 and 8 will not be assessed in the final product.

**Teacher Instructions**

**Prior Knowledge and Skills Required**

To complete this task, students should have some knowledge or skills related to the following:
- applying the concept of likelihood to events in solving problems
- adding and subtracting money amounts and representing the answer in decimal notation
- the relationship between weeks and months

**The Rubric**

The rubric provided with this exemplar task is to be used to assess students’ work. The rubric is based on the achievement chart given on page 9 of *The Ontario Curriculum, Grades 1–8: Mathematics, 1997*.

Before asking students to do the task outlined in this package, review with them the concept of a rubric. Rephrase the rubric so that students can understand the different levels of achievement.

**Accommodations**

Accommodations that are normally provided in the regular classroom for students with special needs should be provided in the administration of the exemplar task.

**Classroom Set-up**

For the investigation of the assigned tasks, the following classroom organization is recommended:
- a meeting area for the whole class
- individual workspaces

**Materials and Resources Required**

Before students attempt a particular task, provide them with the appropriate materials from among the following:
- copies of the student package for each student
- picture book about money
- coins (pennies, nickels, dimes, quarters, dollar coins)
- paper or cloth bag
- paper for labels
- writing instruments (pencils, erasers)
- calculators

*The rubric is reproduced on pages 14–15 of this document.*
Task Instructions
Introductory Activities

Pre-task 1 (40 minutes)
Introduce the tasks with a picture book about money. Pose questions about topics that arise in the book.

Have the students suggest different ways of giving change for a sum of money (e.g., fifteen cents). Record the responses, and ask how students can be sure that they have listed all the possibilities. Elicit from students the method of using a systematic list for recording possibilities.

Pre-task 2 (20 minutes)
Place a nickel, a dime, and a quarter inside a bag. Ask the students:
- “What are the chances of removing the quarter from the bag?”
- “If two coins are removed, what is the probability that the sum is fifteen cents? thirty-five cents?”

Discuss the students’ different approaches to this task.

Pre-task 3 (20 minutes)
Place the following coins in a linear pattern in front of the students, and label the groupings as shown:

dime, nickel, quarter
dime, nickel, quarter

Step 1 Step 2

[This pattern of coins is an example of an a, b, c, a, b, c, . . . pattern.]

Ask:
- “If this pattern continued, what coin would be in the twelfth position? the twentieth position?”
- “How did you arrive at your answer?”

Discuss the strategies that students used in arriving at the answer.

Then ask:
- “What is the total value of the coins at the end of step 1?”
- “What is the combined value of steps 1, 2, and 3? steps 1, 2, 3, 4, and 5?”
- “In how many different ways can you find the answers to these questions?”

Have students discuss their strategies with the rest of the class.

Exemplar Task (three periods of 50 minutes each)
1. Distribute a copy of the student package to each student.
2. The problem that the students will solve independently is provided in the worksheets in Appendix 1.
Lots of Coins!

1. Dawson has the following coins.

   ![Coins](image)

   a. What are all the possible sums you can get by combining three coins? Present your information in such a way that someone looking at your work will see how you solved the problem.

2. Lo said that you can make $9.56 by combining many of the following coins.

   ![Coins](image)

   Do you agree with Lo? Yes □ No □

   Explain why you agree or disagree.
3. Imagine that you have these three coins in your pocket:

![Coins]

If you take two coins out of your pocket, what is the probability that you removed 30 cents?
Show your work.

4. Make up another probability question using coins.
Show how you would solve the problem.
5. Here is a pattern using loonies, quarters, and dimes.

<table>
<thead>
<tr>
<th>Step 1</th>
<th>Step 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>25¢</td>
<td>$1</td>
</tr>
<tr>
<td>25¢</td>
<td>25¢</td>
</tr>
<tr>
<td>10¢</td>
<td></td>
</tr>
</tbody>
</table>

The value of Step 1 is $1.60. The value of Step 2 is $2.20.

If this pattern were to continue, what would be the value of Step 5?

Show how you arrived at your answer. Use the back of the sheet if needed.

6. ESTIMATE how much money you would have if you were given $0.55 each week, and you saved the money for three months.

My estimate is: ____________________________

Show how you estimated your answer.

Organize your work here, and explain your thinking.
Geometry and Spatial Sense
Exploring Designs

The Task
This task required students to:

• investigate what happens when they flip, slide, and turn four identical two-sided square tiles into different positions to create designs in the form of larger squares;
• describe how they moved the tiles to create one of the designs;
• sort the tiles and give the sorting rule;
• use tangram sets to create a tile design having two lines of symmetry.

Students used four congruent tiles composed of shapes from the tangram set to make designs. They arranged the tiles in squares in as many ways as possible and recorded their arrangements, then chose one of these designs to describe. Next, they sorted all the recorded designs and explained their sorting rule. Finally, they used pieces from two tangram sets to design a suncatcher with two lines of symmetry; identified the lines of symmetry; and explained the symmetry.

Expectations
This task gave students the opportunity to demonstrate achievement of all or part of each of the following selected expectations from the Geometry and Spatial Sense strand. Note that the codes that follow the expectations are from the Ministry of Education’s Curriculum Unit Planner (CD-ROM).

Students will:
1. investigate the attributes of three-dimensional figures and two-dimensional shapes using concrete materials and drawings (3m55);
2. explore transformations of geometric figures (3m57);
3. understand key concepts in transformational geometry using concrete materials and drawings (3m58);
4. use language effectively to describe geometric concepts, reasoning, and investigations (3m60);
5. explain the process they followed in making a structure or a picture from three-dimensional figures or two-dimensional shapes (3m68);
6. explore and identify two-dimensional shapes using concrete materials and drawings (e.g., rhombus, parallelogram) (3m70);
7. determine lines of symmetry for two-dimensional shapes using paper folding and reflections in a transparent mirror (3m73);
8. identify transformations, such as flips, slides, and turns (reflections, translations, and rotations), using concrete materials and drawings (3m74);
9. perform rotations using concrete materials (e.g., quarter turn, half turn, three-quarter turn) (3m75).
Prior Knowledge and Skills
To complete this task, students were expected to have some knowledge or skills relating to the following:
• exploring the concept of lines of symmetry in two-dimensional shapes
• determining lines of symmetry for a two-dimensional shape
• creating symmetrical designs
• comparing and sorting two-dimensional shapes according to two or more attributes
• writing sorting rules
• identifying a centre of rotation
• exploring or investigating tangrams

For information on the process used to prepare students for the task and on the materials and equipment required, see the Teacher Package reproduced on pages 96–102 of this document.
## Task Rubric – Exploring Designs

<table>
<thead>
<tr>
<th>Expectations*</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Problem solving</strong></td>
<td><strong>Understanding of concepts</strong></td>
<td><strong>Application of mathematical procedures</strong></td>
<td><strong>Understanding of concepts</strong></td>
</tr>
<tr>
<td>1, 3</td>
<td>The student:</td>
<td>The student:</td>
<td>The student:</td>
<td>The student:</td>
</tr>
<tr>
<td></td>
<td>– selects and applies a problem-solving strategy to create and sort a few simple tile designs</td>
<td>– demonstrates a limited understanding of transformations</td>
<td>– performs a few of the transformation tasks, making many errors and/or omissions</td>
<td>– demonstrates a limited understanding of transformations</td>
</tr>
<tr>
<td>2, 6, 9</td>
<td>– demonstrates a limited understanding of symmetry when determining lines of symmetry, making many errors and/or omissions</td>
<td>– demonstrates some understanding of symmetry when determining lines of symmetry, making some errors and/or omissions</td>
<td>– correctly identifies a two-dimensional shape</td>
<td>– correctly identifies some of the two-dimensional shapes</td>
</tr>
<tr>
<td>3, 7, 8</td>
<td>– demonstrates a limited understanding of transformations</td>
<td>– demonstrates some understanding of transformations</td>
<td>– performs some of the transformation tasks, making some errors and/or omissions</td>
<td>– demonstrates some understanding of symmetry when determining lines of symmetry, making few errors and/or omissions</td>
</tr>
<tr>
<td></td>
<td>– demonstrates a limited understanding of symmetry when determining lines of symmetry, making some errors and/or omissions</td>
<td>– correctly identifies some of the two-dimensional shapes</td>
<td>– correctly identifies many of the two-dimensional shapes</td>
<td>– correctly identifies many of the two-dimensional shapes</td>
</tr>
<tr>
<td></td>
<td>– performs many of the transformation tasks, making few errors and/or omissions</td>
<td>– correctly identifies many of the two-dimensional shapes</td>
<td>– performs most of the transformation tasks, making few, if any, minor errors or omissions</td>
<td>– correctly identifies most of the two-dimensional shapes</td>
</tr>
</tbody>
</table>

*Expectations: 1, 3, 5, 6, 7, 8, 9*

**Problem solving:**
- The student selects and applies a problem-solving strategy to create and sort a few simple tile designs.
- Level 1: Demonstrates limited understanding of transformations.
- Level 2: Demonstrates some understanding of transformations.
- Level 3: Demonstrates a general understanding of transformations.
- Level 4: Demonstrates a thorough understanding of transformations.

**Understanding of concepts:**
- The student demonstrates a limited understanding of symmetry when determining lines of symmetry, making many errors and/or omissions.
- Level 1: Demonstrates limited understanding of symmetry when determining lines of symmetry, making many errors and/or omissions.
- Level 2: Demonstrates some understanding of symmetry when determining lines of symmetry, making some errors and/or omissions.
- Level 3: Demonstrates a general understanding of symmetry when determining lines of symmetry, making few errors and/or omissions.
- Level 4: Demonstrates a thorough understanding of symmetry when determining lines of symmetry, making few, if any, minor errors or omissions.

**Application of mathematical procedures:**
- The student performs a few of the transformation tasks, making many errors and/or omissions.
- Level 1: Performs a few of the transformation tasks, making many errors and/or omissions.
- Level 2: Performs some of the transformation tasks, making some errors and/or omissions.
- Level 3: Performs many of the transformation tasks, making few errors and/or omissions.
- Level 4: Performs most of the transformation tasks, making few, if any, minor errors or omissions.

**Applications:**
- Problem solving
- Understanding of concepts
- Application of mathematical procedures
<table>
<thead>
<tr>
<th>Expectations</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
</tr>
</thead>
</table>
| 4, 5, 8      | - uses symbols, words, pictures, and/or diagrams with limited clarity in describing flips, slides, turns, and symmetry
|              | - explains with limited clarity and precision the process of making a picture from two-dimensional shapes | - uses symbols, words, pictures, and/or diagrams with some clarity in describing flips, slides, turns, and symmetry
|              | - explains with some clarity and precision the process of making a picture from two-dimensional shapes | - explains clearly and precisely the process of making a picture from two-dimensional shapes |
|              | - explains clearly, precisely, and effectively the process of making a picture from two-dimensional shapes | - uses symbols, words, pictures, and/or diagrams clearly and precisely in describing flips, slides, turns, and symmetry |

*The expectations that correspond to the numbers given in this chart are listed on page 60.

Note: This rubric does not include criteria for assessing student performance that falls below level 1.
Student Task Instructions

Exploring Designs
Sandra bought 4 identical two-sided tiles like the four below to make a suncatcher. Cut out the four tiles and investigate how they can be arranged into a square to make interesting designs. How many different designs can you find? As you find each new design, draw it on the recording sheet.
1. Choose the design you like the best and draw it again here.

My favourite design is:

![Design Image]

Tell how you moved the tiles to make this design. Describe the shapes and any lines of symmetry that you see in it.

I folded the paper to that shape.

It has 2 lines of symmetry.

2. Cut out each of your designs from your recording sheets. Sort them into groups. Paste each group on its own paper and explain the sorting rule.

My sorting rule is:

![Sorting Rule Image]
3. For this task you will be designing your own suncatcher. You will need two tangram sets. Use as many pieces as you can from both tangram puzzles to design a suncatcher with two lines of symmetry.

- Draw or paste your suncatcher in the space below.
- Clearly identify the lines of symmetry.
- Colour your suncatcher.

D

4. Explain how your suncatcher is symmetrical.

because it has two lines of symmetry, in the middle of it and the side.
Teacher’s Notes

Problem Solving
- The student selects and applies a problem-solving strategy to create and sort a few simple tile designs (e.g., in question 1, creates a number of tiles; in question 2, sorts the tiles according to different criteria – “all atuch [attach], all out, all dimd [diamond]” – rather than using a consistent sorting rule).

Understanding of Concepts
- The student demonstrates a limited understanding of transformations (e.g., in question 1, uses turns in the favourite design: “I terness the paper to that shape”).
- The student demonstrates a limited understanding of symmetry when determining lines of symmetry, making many errors and/or omissions (e.g., in question 1, states, “It has 2 lines of symmetry” but does not identify them).

Application of Mathematical Procedures
- The student performs a few of the transformation tasks, making many errors and/or omissions (e.g., in the question 1 explanation, mentions only that he or she “terned the paper”).
- The student correctly identifies a two-dimensional shape (e.g., in question 2, uses a diamond shape to sort).

Communication of Required Knowledge
- The student uses symbols, words, pictures, and/or diagrams with limited clarity in describing flips, slides, turns, and symmetry (e.g., in question 1, mentions a turn, but describes it with limited clarity – “I terness the paper” – and makes no mention of degree or direction).
- The student explains with limited clarity and precision the process of making a picture from two-dimensional shapes (e.g., in question 1, simply describes the process used as a turn, but does not give specifics such as a $\frac{1}{4}$ or a $\frac{3}{4}$ turn; in question 4, simply describes the location of symmetry as “the metl of it and the side”).

Comments/Next Steps
- The student should continue manipulating concrete materials such as tangram pieces when creating designs.
- The student should use more mathematical terminology when discussing how two-dimensional shapes can be manipulated by using slides, flips, and turns.
- The student needs to become more familiar with the names of two-dimensional shapes.
- The student should develop a broader vocabulary to describe symmetry (e.g., horizontal, vertical, diagonal).
- The student should refer to word charts or a personal dictionary for correct spellings.
Exploring Designs  Level 1, Sample 2

A

1. Choose the design you like the best and draw it again here.

My favourite design is:

Tell how you moved the tiles to make this design. Describe the shapes and any lines of symmetry that you see in it.

I took them to make a diamond.
then I took lines and put up the turns.
I see a square.

I see 10 lines of symmetry!!

B

2. Cut out each of your designs from your recording sheets. Sort them into groups. Paste each group on its own paper and explain the sorting rule.

My sorting rule is:

favorite
3. For this task you will be designing your own suncatcher. You will need two tangram sets. Use as many pieces as you can from both tangram puzzles to design a suncatcher with two lines of symmetry.

- Draw or paste your suncatcher in the space below.
- Clearly identify the lines of symmetry.
- Colour your suncatcher.
Teacher’s Notes

Problem Solving
- The student selects and applies a problem-solving strategy to create and sort a few simple tile designs (e.g., in question 1, creates a number of tiles; in question 2, sorts the tiles according to a criterion).

Understanding of Concepts
- The student demonstrates a limited understanding of transformations (e.g., in question 1, gives a limited description: “... then I took lines and Put up the turns”).
- The student demonstrates a limited understanding of symmetry when determining lines of symmetry, making many errors and/or omissions (e.g., in question 1, states inaccurately, “I see 10 lines of cemetry [symmetry]”).

Application of Mathematical Procedures
- The student performs a few of the transformation tasks, making many errors and/or omissions (e.g., in question 1, indicates that turns are used to create the design; in question 4, incorrectly identifies one vertical line of symmetry that applies to the “dimond’s” only).
- The student correctly identifies a two-dimensional shape (e.g., in questions 1 and 2, identifies the diamond shape).

Communication of Required Knowledge
- The student uses symbols, words, pictures, and/or diagrams with limited clarity in describing flips, slides, turns, and symmetry (e.g., in question 1, indicates that turns are used to create the design but does not indicate directionality or degree, such as $\frac{1}{4}$ turn clockwise).
- The student explains with limited clarity and precision the process of making a picture from two-dimensional shapes (e.g., in question 1, explains, “I took them to make a dimound then I took lines and Put up the turns”).

---

4. Explain how your suncatcher is symmetrical.

```
Cause if you look at my
dimonds You can go down and still
look the same
```
Comments/Next Steps

- The student should continue to manipulate two-dimensional shapes such as tangram pieces.
- The student needs to work on recognizing two-dimensional shapes and using correct terminology in naming them.
- The student needs to use mathematical language clearly to describe transformations and sorting rules.
- The student should refer to word charts or a personal dictionary for correct spellings.
Exploring Designs  Level 2, Sample 1

A

1. Choose the design you like the best and draw it again here.

My favourite design is:

Tell how you moved the tiles to make this design. Describe the shapes and any lines of symmetry that you see in it.

I see a triangle in the middle. There is a line of symmetry down the middle and in the sender. I turned the square.

B

2. Cut out each of your designs from your recording sheets. Sort them into groups. Paste each group on its own paper and explain the sorting rule.

My sorting rule is: is hastype have a dimension.
3. For this task you will be designing your own suncatcher. You will need two tangram sets. Use as many pieces as you can from both tangram puzzles to design a suncatcher with two lines of symmetry.

- Draw or paste your suncatcher in the space below.
- Clearly identify the lines of symmetry.
- Colour your suncatcher.
4. Explain how your suncatcher is symmetrical.

"It is symmetrical because it is the same on both sides."

**Teacher’s Notes**

**Problem Solving**
- The student selects and applies an appropriate problem-solving strategy to create and sort some simple tile designs (e.g., in question 1, repeats some tile designs; in question 2, accurately sorts according to self-selected criteria, diamond and no diamond).

**Understanding of Concepts**
- The student demonstrates some understanding of transformations (e.g., in question 1, creates a design, and identifies how the tiles were moved to create the design).
- The student demonstrates some understanding of symmetry when determining lines of symmetry, making some errors and/or omissions (e.g., in question 1, identifies the lines of symmetry as being "down the middle and in the sender [centre]"; in question 3, draws a line of symmetry through the suncatcher).

**Application of Mathematical Procedures**
- The student performs some of the transformation tasks, making some errors and/or omissions (e.g., in question 1, uses a flip and slides or turns to create the design in the picture but states only that he or she "turned the square").
- The student correctly identifies some of the two-dimensional shapes (e.g., in question 1, identifies triangles; in question 2, identifies a diamond shape as the sorting rule).

**Communication of Required Knowledge**
- The student uses symbols, words, pictures, and/or diagrams with some clarity in describing flips, slides, turns, and symmetry (e.g., in question 1, labels the steps of the transformation and describes a part of the process used with some clarity).
- The student explains with some clarity and precision the process of making a picture from two-dimensional shapes (e.g., in question 1, "I turned the square" describes with some clarity the process used to make the design).
Comments/Next Steps
- The student should continue to manipulate two-dimensional shapes such as tangrams.
- The student needs to practise describing transformations such as slides, flips, and turns.
- The student needs to develop mathematical vocabulary.
- The student should refer to word charts or a personal dictionary for correct spellings.
Exploring Designs  Level 2, Sample 2

A

1. Choose the design you like the best and draw it again here.

My favourite design is:

Tell how you moved the tiles to make this design. Describe the shapes and any lines of symmetry that you see in it.

at the top I flipped it then I went back to the start then flipped the bottom then from that one flip it again.

there is 4 lines of symmetry the shapes I see are a square and triangles and a diamond

B

2. Cut out each of your designs from your recording sheets. Sort them into groups. Paste each group on its own paper and explain the sorting rule.

My sorting rule is:

they have little line sticking out
My sorting rule: they have no little lines sticking out.

My sorting rule: they have 3 lines sticking out.
My sorting rule: they have three lines sticking out.

3. For this task you will be designing your own suncatcher. You will need two tangram sets. Use as many pieces as you can from both tangram puzzles to design a suncatcher with two lines of symmetry.

- Draw or paste your suncatcher in the space below.
- Clearly identify the lines of symmetry.
- Colour your suncatcher.
Teacher’s Notes

Problem Solving
- The student selects and applies an appropriate problem-solving strategy to create and sort some simple tile designs (e.g., in question 1, creates some repeated designs; in question 2, accurately sorts according to different criteria, namely, 0, 2, 3, or 4 “little lines sticking out”).

Understanding of Concepts
- The student demonstrates some understanding of transformations (e.g., in question 3, creates a suncatcher that has two lines of symmetry by using form and colour, but does not paste the shapes for the suncatcher precisely; in question 1, identifies the tiles as flipped).
- The student demonstrates some understanding of symmetry when determining lines of symmetry, making some errors and/or omissions (e.g., in question 1, correctly identifies the lines of symmetry).

Application of Mathematical Procedures
- The student performs some of the transformation tasks, making some errors and/or omissions (e.g., in question 1, uses flips correctly to create the design; in question 2, does not use transformations to sort).
- The student correctly identifies some of the two-dimensional shapes (e.g., in question 1, identifies “a square and 8 triangles and a diamond”).

Communication of Required Knowledge
- The student uses symbols, words, pictures, and/or diagrams with some clarity in describing flips, slides, turns, and symmetry (e.g., in question 1, uses only words to describe how the tiles are moved: “at the top I flipped it”).
- The student explains with some clarity and precision the process of making a picture from two-dimensional shapes (e.g., in question 1, describes the process of flipping the tiles but is not specific: “then from that one flip it again”; in question 4, describes the process of checking symmetry but is not specific: “when you fold it they match”).

4. Explain how your suncatcher is symmetrical.

My suncatcher has Symmetrical lines so when you fold it they match.
Comments/Next Steps
- The student should continue manipulating two-dimensional shapes.
- The student should include more detail and be more precise in describing transformations and symmetry (e.g., include directionality and a starting point).
1. Choose the design you like the best and draw it again here.

My favourite design is:

\[ \begin{align*}
1 &= \text{one} \\
2 &= \text{two} \\
3 &= \text{three} \\
4 &= \text{four}
\end{align*} \]

\[ p = \text{position} \]

Tell how you moved the tiles to make this design. Describe the shapes and any lines of symmetry that you see in it. The name is the weigh scale because so the two colour is circles is on the bottom right it looks like a weigh scale. \( p1 \) slides over to \( p2 \). \( p1 \) slides down to \( p3 \). \( p4 \) is a half turn to \( p1 \). \( p1 \) and \( p4 \) are symmetric also \( p2 \) and \( p3 \) are symmetric. My design has squares and triangles. I see a rectangle.

2. Cut out each of your designs from your recording sheets. Sort them into groups. Paste each group on its own paper and explain the sorting rule.

My sorting rule is:

<table>
<thead>
<tr>
<th>Slides and turn</th>
<th>Slides and turn</th>
<th>Slides and turn</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3. For this task you will be designing your own suncatcher. You will need two tangram sets. Use as many pieces as you can from both tangram puzzles to design a suncatcher with two lines of symmetry.

- Draw or paste your suncatcher in the space below.
- Clearly identify the lines of symmetry.
- Colour your suncatcher.

4. Explain how your suncatcher is symmetrical.

I know because I used a mirror to identify if it was symmetrical or not and it was symmetrical. I know the shapes are symmetrical because the same shapes need to be the same colour and I coloured the other shapes the same colour.
Teacher’s Notes

Problem Solving
– The student selects and applies an appropriate problem-solving strategy to create and sort a variety of tile designs (e.g., in question 1, uses colour to create a number of tile designs; in question 2, sorts the tiles according to transformations – turns, slides, and flips).

Understanding of Concepts
– The student demonstrates a general understanding of transformations (e.g., in question 1, includes specific vocabulary in describing how the design is created: “p1 slides down to p3. P4 is a half turn to p1”).
– The student demonstrates a general understanding of symmetry when determining lines of symmetry, making few errors and/or omissions (e.g., in question 4, creates and identifies a suncatcher that has two lines of symmetry according to form and colour).

Application of Mathematical Procedures
– The student performs many of the transformation tasks, making few errors and/or omissions (e.g., in question 3, uses his or her knowledge of flips to create a suncatcher that is symmetrical in form and colour; in question 1, correctly uses slides and turns to create the design; in question 2, misidentifies the design made by flips).
– The student correctly identifies many of the two-dimensional shapes (e.g., in question 1, “my design has squares and triangles. I see a rectangle”).

Communication of Required Knowledge
– The student uses symbols, words, pictures, and/or diagrams clearly in describing flips, slides, turns, and symmetry (e.g., in question 1, uses labels, symbols, numbers, and words to describe the process of creating the favourite design; in question 4, tells about using a “mirra” to determine symmetry).
– The student explains clearly and precisely the process of making a picture from two-dimensional shapes (e.g., in question 4, recognizes that the same shapes and colours are needed for the design to be symmetrical).

Comments/Next Steps
– The student needs to use precise mathematical language to record the data.
– The student should continue to use words, labels, diagrams, and numbers in describing solutions.
1. Choose the design you like the best and draw it again here.

**My favourite design is:**

```
1 2
3
```

Tell how you moved the tiles to make this design. Describe the shapes and any lines of symmetry that you see in it.

I have put all the big triangles on the outside and made a diamond with all the little triangles. With the little triangles I made a big X in the middle of the diamond. There are 4 lines of symmetry too. Each part is a quarter turn to the next.

2. Cut out each of your designs from your recording sheets. Sort them into groups. Paste each group on its own paper and explain the sorting rule.

**My sorting rule is:**

My sorting rule is diamonds in the middle and at least one line of symmetry.
My sorting rule is no diamonds in the middle and no lines of symmetry.

My sorting rule is no diamonds in the middle and at least one line of symmetry.
3. For this task you will be designing your own suncatcher. You will need two tangram sets. Use as many pieces as you can from both tangram puzzles to design a suncatcher with two lines of symmetry.

- Draw or paste your suncatcher in the space below.
- Clearly identify the lines of symmetry.
- Colour your suncatcher.

4. Explain how your suncatcher is symmetrical.

   My suncatcher is symmetrical by 2 ways because if I fold it vertical each side would look the same and if I fold it horizontal it would look the same on each side.
Teacher’s Notes

Problem Solving
- The student selects and applies an appropriate problem-solving strategy to create and sort a variety of tile designs (e.g., in question 1, creates a wide variety of tiles; in question 2, sorts according to shape and symmetry).

Understanding of Concepts
- The student demonstrates a general understanding of transformations (e.g., in question 1, describes designs in terms of shapes – “big triangles on the outside and a diamond with all the little triangles” – and includes transformational terminology in the description).
- The student demonstrates a general understanding of symmetry when determining lines of symmetry, making few errors and/or omissions (e.g., in question 1, correctly identifies four lines of symmetry; in question 3, creates a suncatcher that has two lines of symmetry according to form and colour).

Application of Mathematical Procedures
- The student performs many of the transformation tasks, making few errors and/or omissions (e.g., in question 3, accurately uses a knowledge of flips to create a suncatcher that is symmetrical in form and colour).
- The student correctly identifies many of the two-dimensional shapes (e.g., in question 1, refers to triangles and diamonds).

Communication of Required Knowledge
- The student uses symbols, words, pictures, and/or diagrams clearly in describing flips, slides, turns, and symmetry (e.g., in question 1, uses words and labels to describe the process of creating the design, including transformational terminology).
- The student explains clearly and precisely the process of making a picture from two-dimensional shapes (e.g., in question 4, clearly describes the process of using paper folding to determine the symmetry of the suncatcher: “… if I fold it vertical each side would look the same and if I fold it horizontal it would look the same on each side”).

Comments/Next Steps
- The student should be more specific when describing transformations (e.g., discuss direction, distance, and location).
- The student needs to use labels, numbers, and pictures, in addition to words, to communicate more clearly.
- The student needs to include more detail in descriptions (e.g., the location of the folds).
**Exploring Designs**  
**Level 4, Sample 1**

**A**

1. Choose the design you like the best and draw it again here.

*My favourite design is:*

Tell how you moved the tiles to make this design. Describe the shapes and any lines of symmetry that you see in it.

*My design has 4 big triangles and 8 small triangles. It has 4 lines of symmetry: 2 diagonal, 1 across and 1 down. I see a diamond in my design and an X. First I took the Y shaped tiles and then I drew it in the right bottom square. Then I turned it to the left and drew it in the left bottom square. Then I flipped it from the turn that I made and then I drew it in the left top square. Then I turned it to the right and drew it in the top right square. Then I coloured it and this is how it turned out.*

**B**

2. Cut out each of your designs from your recording sheets. Sort them into groups. Paste each group on its own paper and explain the sorting rule.

*My sorting rule is: 1 line of symmetry*
3. For this task you will be designing your own suncatcher. You will need two tangram sets. Use as many pieces as you can from both tangram puzzles to design a suncatcher with two lines of symmetry.

- Draw or paste your suncatcher in the space below.
- Clearly identify the lines of symmetry.
- Colour your suncatcher.
Teacher’s Notes

Problem Solving
- The student selects and applies an appropriate problem-solving strategy to create and sort a wide variety of tile designs (e.g., in question 1, systematically uses colour to create tile designs; in question 2, sorts the tiles according to the number of lines of symmetry).

Understanding of Concepts
- The student demonstrates a thorough understanding of transformations (e.g., in question 1, uses turns and flips to create the favourite design: “I turned it to the left” and “I flipped it from the turn that I made”).
- The student demonstrates a thorough understanding of symmetry when determining lines of symmetry, making few, if any, minor errors or omissions (e.g., in question 3, creates a symmetrical suncatcher by using colour patterns and form; in the description in question 4, identifies the two lines of symmetry for the suncatcher; and in question 1, accurately identifies four lines of symmetry in the favourite design as “2 diagonal, 1 across and 1 down”).

Application of Mathematical Procedures
- The student performs most of the transformation tasks, making few, if any, minor errors or omissions (e.g., in question 3, uses a variety of colours and uses flips with almost all of the tangram pieces to create a suncatcher; in question 1, correctly uses turns and a flip to produce the design).
- The student correctly identifies most of the two-dimensional shapes (e.g., in question 1, identifies “4 big triangles and 8 small triangles” as well as a diamond and squares).

Communication of Required Knowledge
- The student uses symbols, words, pictures, and/or diagrams clearly and precisely in describing flips, slides, turns, and symmetry (e.g., in question 1, describes the process used to create a design by recording specific steps (“then I turned it to the right”)).

4. Explain how your suncatcher is symmetrical.

My suncatcher is symmetrical down the middle and across. It is symmetrical because I made sure that I put the same shapes on both sides and then checked it then glued it down. Then I divided the shapes the same on both sides. Then I coloured it in the same so it is symmetrical.
The student explains clearly, precisely, and effectively the process of making a picture from two-dimensional shapes (e.g., in question 1, specifically outlines in order how the sections of the design are related; in question 4, explains the steps used to create and check a symmetrical suncatcher).

**Comments/Next Steps**
- The student could make descriptions of turns more quantitative (e.g., discuss the degree of turns) when describing transformations.
- The student should include labelling on diagrams (e.g., of lines of symmetry).
- The student could use vocabulary for discussing symmetry more precisely (e.g., horizontal and vertical rather than across and down).
Exploring Designs  Level 4, Sample 2

A

1. Choose the design you like the best and draw it again here.

My favourite design is:

Tell how you moved the tiles to make this design. Describe the shapes and any lines of symmetry that you see in it.

My design has 2 big triangles and 8 small triangles. It has 2 lines of symmetry. There is one going down, and there is one going across. I flipped my shapes all 4 times to make my design. The two big pink triangles are touching tips, going across. The eight triangles together make two big, blue triangles. Their tips are touching too. The two pink triangles together make or look like a bow tie.

B

2. Cut out each of your designs from your recording sheets. Sort them into groups. Paste each group on its own paper and explain the sorting rule.

My sorting rule is: 0 lines of symmetry.

1 Line of symmetry.
2 lines of symmetry.

4 lines of symmetry.

3. For this task you will be designing your own suncatcher. You will need two tangram sets. Use as many pieces as you can from both tangram puzzles to design a suncatcher with two lines of symmetry.

- Draw or paste your suncatcher in the space below.
- Clearly identify the lines of symmetry.
- Colour your suncatcher.
4. Explain how your suncatcher is symmetrical.

I have 2 lines of symmetry. 1 is going down, and 1 is going across. My colors match each other, and my shapes match going down or across. I used all of the tangram pieces, except for the 2 rhombuses. I could not use them because when you cut them in half, they are not symmetrical.

Teacher’s Notes

Problem Solving
- The student selects and applies an appropriate problem-solving strategy to create and sort a wide variety of tile designs (e.g., in question 1, systematically creates different tile designs by using form and colour; and in question 2, accurately sorts the tiles according to the number of lines of symmetry by form and colour).

Understanding of Concepts
- The student demonstrates a thorough understanding of transformations (e.g., in question 1, flips the tile around the lines of symmetry to create a design, as described by “flipped my shapes all four times”).
- The student demonstrates a thorough understanding of symmetry when determining lines of symmetry, making few, if any, minor errors or omissions (e.g., in question 1, accurately uses the number of lines of symmetry as the criterion in sorting the designs; in question 4, justifies omitting rhombuses from the suncatcher design because they are not symmetrical).

Application of Mathematical Procedures
- The student performs most of the transformation tasks, making few, if any, minor errors or omissions (e.g., in question 1, performs four flips to create the design; in question 3, uses his or her knowledge of flips to create a suncatcher that is symmetrical in form and colour).
- The student correctly identifies most of the two-dimensional shapes (e.g., in question 1, “2 big triangles and 8 small triangles”; in question 4, “rhombuses”).

Communication of Required Knowledge
- The student uses symbols, words, pictures, and/or diagrams clearly and precisely in describing flips, slides, turns, and symmetry (e.g., in question 1, describes the process used by saying, “I flipped my shapes all 4 times to make my design”).
- The student explains clearly, precisely, and effectively the process of making a picture from two-dimensional shapes (e.g., in question 4, the symmetry of the suncatcher is explained as colours and shapes that match going down or across).
Comments/Next Steps
- The student should be more specific when describing transformations (e.g., by discussing direction, distance, and location).
- The student should develop a broader vocabulary for discussing different types of symmetry (e.g., horizontal and vertical line symmetry).
- The student should ensure that all diagrams are labelled according to directions.
Mathematics Exemplar Task
Grade 3 – Geometry and Spatial Sense
Teacher Package

Expectations Addressed in the Exemplars Task
Note that the codes that follow the expectations are from the Ministry of Education’s Curriculum Unit Planner (CD-ROM).

Students will:
1. investigate the attributes of three-dimensional figures and two-dimensional shapes using concrete materials and drawings (3m55);
2. explore transformations of geometric figures (3m57);
3. understand key concepts in transformational geometry using concrete materials and drawings (3m58);
4. use language effectively to describe geometric concepts, reasoning, and investigations (3m60);
5. explain the process they followed in making a structure or a picture from three-dimensional figures or two-dimensional shapes (3m68);
6. explore and identify two-dimensional shapes using concrete materials and drawings (e.g., rhombus, parallelogram) (3m70);
7. determine lines of symmetry for two-dimensional shapes using paper folding and reflections in a transparent mirror (3m73);
8. identify transformations, such as flips, slides, and turns (reflections, translations, and rotations), using concrete materials and drawings (3m74);
9. perform rotations using concrete materials (e.g., quarter turn, half turn, three-quarter turn) (3m75).

Teacher Instructions
Prior Knowledge and Skills Required
To complete this task, students should have some knowledge or skills related to the following:
• exploring the concept of lines of symmetry in two-dimensional shapes
• determining lines of symmetry for a two-dimensional shape
• creating symmetrical designs
• comparing and sorting two-dimensional shapes according to two or more attributes
• writing sorting rules
• identifying a centre of rotation
• exploring or investigating tangrams

Title: Exploring Designs
Time Requirements: 120 minutes (total)
• 15 minutes to complete Pre-task 1
• 15 minutes to complete Pre-task 2
• 15 minutes to complete Pre-task 3
• 30 minutes to complete question 1
• 45 minutes to complete questions 2 to 4

Description of the Task
This task will require students to:
• investigate what happens when they flip, slide, and turn 4 identical two-sided square tiles into different positions to create designs in the form of larger squares;
• describe how they moved the tiles to create one of the designs;
• sort the tiles and give the sorting rule;
• use tangram sets to create a tile design having two lines of symmetry.

Students will use four congruent tiles composed of shapes from the tangram set to make designs. They will arrange the tiles in squares in as many ways as possible and will record their arrangements, then will choose one of those designs to describe. Next, they will sort all the recorded designs and explain their sorting rule. Finally, they will use pieces from two tangram sets to design a suncatcher with two lines of symmetry; will identify the lines of symmetry; and will explain the symmetry.
The Rubric*
The rubric provided with this exemplar task is to be used to assess students’ work. The rubric is based on the achievement chart given on page 9 of *The Ontario Curriculum, Grades 1–8: Mathematics, 1997.*

Before asking students to do the task outlined in this package, review with them the concept of a rubric. Rephrase the rubric so that students can understand the different levels of achievement.

Accommodations
Accommodations that are normally provided in the regular classroom for students with special needs should be provided in the administration of the exemplar task.

Classroom Set-up
For the investigation of the assigned tasks, the following classroom organization is recommended:
- During Pre-task 1, students will be working in pairs and should be able to see the chalkboard ledge as geoboards are sorted.
- During Pre-task 2, students will discuss in a whole class setting and may need to move into a circle to see the geoboards if they are on the floor.
- During Pre-task 3, students will make their designs independently and then share with a partner.
- For the exemplar task, students will work individually and independently.

Materials and Resources Required
Before students attempt a particular task, provide them with the appropriate materials from among the following:
- copies of the student package for each student
- writing instruments (pencils, erasers)
- geoboards (one for each pair of students) and 4 clear geoboards
- design recording sheet on chart paper or on the overhead
- tangrams (two sets for each student, or use the template in Appendix 2)
- glue
- scissors
- red plastic mirrors
- rulers
- coloured pencils or crayons
- overhead projector (optional)
- newsprint or construction paper (optional)
- clear tape

General Instructions

Setting the Stage
All the student work is to be completed in its entirety at school.

Students are to work in pairs for Pre-task 1; as a whole class for Pre-task 2; and independently, then sharing with a partner, for Pre-task 3. Students are to work individually and independently to complete the exemplar task.

These activities allow students to conduct investigations by using their knowledge of transformational geometry and two-dimensional geometry. The designs that the students make are for suncatchers, ornaments in the style of stained glass that are hung in windows to catch or reflect the light. Students should realize that they can flip a tile and see the same design on both sides. If possible, show students a glass or plastic suncatcher or have various students describe ones that they have seen. Reading picture books that include suncatchers or tangrams would also be helpful. You can find additional information about suncatchers on various websites.

Encourage the use of red plastic mirrors and paper folding during introductory activities, and make red plastic mirrors available during student independent activities.

Sorting the Designs
When the students sort their designs, they may have more designs than the space on the recording sheets allows. Provide these students with newsprint or construction paper onto which to glue their sorting groups. The students can write their sorting rule across the bottom of the paper.

Posting a Word List
It would be useful to post a chart listing mathematical language that is currently being developed or used during the task. Such a chart will provide the students with a resource to use when communicating their mathematical learning. Words that you may include for this task are: flip, slide, turn, line of symmetry.

The Pre-tasks
The pre-tasks are designed to review and reinforce the skills and concepts that students will be using in the exemplar task and to model strategies useful in completing the task.

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*The rubric is reproduced on pages 62–63 of this document.*
Task Instructions

Introductory Activities

Pre-task 1: Lines of Symmetry (15 minutes)
This is a pair activity.

Give each pair of students a geoboard. Have the students create a design on their board. Have some of the students place their geoboards on the ledge of the chalkboard. Sort the boards according to the number of lines of symmetry. Have students try to identify the sorting rule. Have other students state the group in which their design would belong. Ask some of the students to prove their answer by showing the lines of symmetry.

Invite other students to sort the designs in other ways. Have them describe the sorting rules.

Pre-task 2: Creating Designs (15 minutes)
This is a teacher-led discussion for the entire class.

Use the overhead with four clear geoboards, or use four geoboards placed on the floor for all the students to see. Make a simple design such as the one below, and repeat it on each of the geoboards.

Have the students suggest how the four geoboards can be placed to create a square. Discuss how the design changes when you use flips, turns, or slides. Ask:
- “What are the different ways that we can move the geoboard?” (flip, slide, turn)
- “Do any of the moves make the same design?”
- “How many designs do you think we can make?”

Create a recording sheet on chart paper or on the overhead (use the Design Recording Sheet in the student package as a guide – see Appendix 1). Show the students how to record one of the designs, and have a few students also record designs.

Pre-task 3: Tangram Design (15 minutes)
This is a partner activity.

Give each student a tangram set or a template of the tangram pieces (see Appendix 2). Have each student work independently, using the tangram pieces to make two-dimensional shapes, and then share his or her designs or pictures with a partner.

Exemplar Task (75 minutes)

1. Distribute a copy of the student package to each student.
2. Distribute two sets of tangrams to each student. The tangram template (see Appendix 2) can be used if commercial tangram sets are not available.
3. The problem that the students will solve independently is provided in the worksheets in Appendix 1.
Appendix 1: Student Worksheets

Exploring Designs

Sandra bought 4 identical two-sided tiles like the four below to make a suncatcher. Cut out the four tiles and investigate how they can be arranged into a square to make interesting designs. How many different designs can you find? As you find each new design, draw it on the recording sheet.

Design Recording Sheet
1. Choose the design you like the best and draw it again here.

My favourite design is:

Tell how you moved the tiles to make this design. Describe the shapes and any lines of symmetry that you see in it.
2. Cut out each of your designs from your recording sheets. Sort them into groups. Paste each group on its own paper and explain the sorting rule.

   My sorting rule is:

3. For this task you will be designing your own suncatcher. You will need two tangram sets. Use as many pieces as you can from both tangram puzzles to design a suncatcher with two lines of symmetry.

   • Draw or paste your suncatcher in the space below.
   • Clearly identify the lines of symmetry.
   • Colour your suncatcher.
4. Explain how your suncatcher is symmetrical.

Appendix 2: Tangram Template

[Diagram of tangram pieces]
Patterning and Algebra
Patterns on the Hundreds Board

The Task
This task required students to:
- investigate growing and shrinking patterns on different configurations of the hundreds board;
- identify and describe the patterns on the hundreds board;
- explain the pattern rules and extend the patterns.

Students found different patterns on the hundreds board, recorded them, stated a pattern rule, and extended the pattern to the next number. Then, after examining how some numbers were positioned on hundreds boards, students filled in other numbers on the boards to create a pattern and explained or described the pattern or gave the pattern rule. On one board, students coloured the numbers that summed to 6 and then to 7, and discussed what they observed. Finally, students created their own pattern on a blank hundreds chart, described the pattern, and asked a question about it.

Expectations
This task gave students the opportunity to demonstrate achievement of all or part of each of the following selected expectations from the Patterning and Algebra strand. Note that the codes that follow the expectations are from the Ministry of Education’s Curriculum Unit Planner (CD-ROM).

Students will:
1. recognize that patterning results from repetition (3m77);
2. identify, extend, and create linear and non-linear geometric patterns, number and measurement patterns, and patterns in their environment (3m78);
3. identify relationships between and among patterns (3m80);
4. understand patterns in which operations are repeated (e.g., multiplication), transformations are repeated, or multiple changes are made to attributes (3m81);
5. discuss the choice of a pattern rule (3m84);
6. given a rule, extend a pattern and describe it in informal mathematical language (e.g., starting at 3, add 3 to each number to create a pattern) (3m85);
7. use addition and subtraction facts to generate simple patterns in a hundreds chart (3m86).
**Prior Knowledge and Skills**

To complete this task, students were expected to have some knowledge or skills relating to the following:

- repeating an operation to make a pattern
- adding, subtracting, and multiplying whole numbers
- exploring multiples on the hundreds board
- recognizing numerical growing and shrinking patterns
- explaining pattern rules
- using a calculator for repeated addition
- recognizing patterns in numbers (e.g., along diagonals)

*For information on the process used to prepare students for the task and on the materials and equipment required, see the Teacher Package reproduced on pages 156–164 of this document.*
## Task Rubric – Patterns on the Hundreds Board

<table>
<thead>
<tr>
<th>Expectations*</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Problem solving</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2, 3</td>
<td>- selects and applies a problem-solving strategy to identify, extend, and create number patterns, arriving at an incomplete or inaccurate solution</td>
<td>- selects and applies an appropriate problem-solving strategy to identify, extend, and create number patterns, arriving at a partially complete and/or partially accurate solution</td>
<td>- selects and applies an appropriate problem-solving strategy to identify, extend, and create number patterns, arriving at a generally complete and accurate solution</td>
<td>- selects and applies an appropriate problem-solving strategy to identify, extend, and create number patterns, arriving at a thorough and accurate solution</td>
</tr>
<tr>
<td><strong>Understanding of concepts</strong></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>1, 4</td>
<td>- demonstrates a limited understanding of patterning in describing a few of the number patterns</td>
<td>- demonstrates some understanding of patterning in describing some of the number patterns</td>
<td>- demonstrates a general understanding of patterning in describing many of the number patterns</td>
<td>- demonstrates a thorough understanding of patterning in describing most or all of the number patterns</td>
</tr>
<tr>
<td><strong>Application of mathematical procedures</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6, 7</td>
<td>- extends patterns, making many errors and/or omissions</td>
<td>- extends patterns, making some errors and/or omissions</td>
<td>- extends patterns, making few errors and/or omissions</td>
<td>- extends patterns accurately</td>
</tr>
<tr>
<td></td>
<td>- uses addition and subtraction to generate number patterns, making many errors and/or omissions</td>
<td>- uses addition and subtraction to generate number patterns, making some errors and/or omissions</td>
<td>- uses addition and subtraction to generate number patterns, making few errors and/or omissions</td>
<td>- uses addition and subtraction to generate number patterns, making few, if any, minor errors or omissions</td>
</tr>
<tr>
<td><strong>Communication of required knowledge</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>- uses symbols, words, pictures, and/or diagrams with limited clarity in describing patterns and pattern rules</td>
<td>- uses symbols, words, pictures, and/or diagrams with some clarity in describing patterns and pattern rules</td>
<td>- uses symbols, words, pictures, and/or diagrams clearly in describing patterns and pattern rules</td>
<td>- uses symbols, words, pictures, and/or diagrams clearly and precisely in describing patterns and pattern rules</td>
</tr>
</tbody>
</table>

*The expectations that correspond to the numbers given in this chart are listed on page 104.

Note: This rubric does not include criteria for assessing student performance that falls below level 1.
1. Find two patterns on the Hundreds Board.

Record your patterns.

1a) My rule for Pattern A is: count by 2.

The next number in the pattern would be: The next number will be 3.
b) My rule for Pattern B is:

1 3 5 7 9 11
13 15 17 19

The next number in the pattern would be:

The next number will be 21

2. On this board the numbers are in different places. Look for the pattern. Fill in the numbers. Stop at 25.
b) Explain how the numbers are arranged.

They are arranged because it looks like this:

\[ \begin{array}{c}
7 & 8 & 9 \\
6 & 4 & 3
\end{array} \]

c) Can you extend the pattern in another way? Explain your thinking.

I can extend my pattern. I could put that:

\[ \begin{array}{c}
7 & 8 & 9 \\
6 & 4 \\
5 & -2 & 3
\end{array} \]

3. Look for the pattern on the Hundreds Board. Fill in the numbers to 25.

The pattern rule is: \[ +1 \]
4a) Create a number pattern on the Board below.

My pattern rule is:

10 9 8 7 6 5 4 3 2 1

5. Create a different pattern on the Hundreds Board. Colour all the numbers that sum to 6.

b) Describe your pattern.
c) If you were to colour all the numbers that sum to 7, would you be colouring more or fewer numbers?
Give reasons for your answer.

You would be fewer more numbers because 7 is larger.

d) Now colour all the numbers that sum to 7. What do you notice?

7 14 21 28 35 42
49 56 63

6 a) Make your own pattern on this Hundreds Board.

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</table>

b) Describe why it is a pattern.

My pattern is 2 skip one.
Teacher’s Notes

Problem Solving
- The student selects and applies a problem-solving strategy to identify, extend, and create number patterns, arriving at an incomplete or inaccurate solution (e.g., in question 4, identifies the pattern as “10 9 8 7 6 5 4 3 2 1” but does not record it this way on the board).

Understanding of Concepts
- The student demonstrates a limited understanding of patterning in describing a few of the number patterns (e.g., in question 4).

Application of Mathematical Procedures
- The student extends patterns, making many errors and/or omissions (e.g., incorrectly extends the pattern to 25 in question 3).
- The student uses addition and subtraction to generate number patterns, making many errors and/or omissions (e.g., in questions 5 and 5b, creates a number pattern identified as “+ 6” and inaccurately extends it).

Communication of Required Knowledge
- The student uses symbols, words, pictures, and/or diagrams with limited clarity in describing patterns and pattern rules (e.g., in question 1b, states that the pattern rule is “1 3 5 7 . . .”; in question 2c, is unclear in explaining “I can extend my pattern I could of put that 7 8 9 6 1 4 5–2 3”).

Comments/Next Steps
- The student needs to explore a variety of patterns on the hundreds board, using different operations.
- The student needs to use clear mathematical language and notation to describe number patterns.
- The student should explore patterns by using a variety of concrete materials (e.g., pattern blocks, geoboards).
1. Find two patterns on the Hundreds Board.

Record your patterns.

1a) My rule for Pattern A is:

I count by 2.

The next number in the pattern would be:

4, 6, 8, 10, 12, 14, 16.
b) My rule for Pattern B is:

I count by 5

The next number in the pattern would be:

The next number is 10

2. On this board the numbers are in different places. Look for the pattern. Fill in the numbers. Stop at 25.

```
13 14 15 16
12 7 8 9 10
20 6 1 2 11
19 5 4 3 12
17 16 15 14 13
```
b) Explain how the numbers are arranged. They are arranged by the odd numbers.

c) Can you extend the pattern in another way? Explain your thinking. I do not think so because there can only be odd numbers that go up to 25.

3. Look for the pattern on the Hundreds Board. Fill in the numbers to 25.

```
   |   |   |
---|---|---|
   | 2 | 6 |
---|---|---|
   | 5 | 9 |
---|---|---|
   | 6 | 12|
---|---|---|
   |10 |15 |
---|---|---|
   |14 |18 |
---|---|---|
   |16 |21 |
```

The pattern rule is:
4a) Create a number pattern on the Board below.

My pattern rule is: Count by 5

b) Describe your pattern.

5. Create a different pattern on the Hundreds Board. Colour all the numbers that sum to 6.
c) If you were to colour all the numbers that sum to 7, would you be colouring more or fewer numbers? Give reasons for your answer.

You should put a fewer because 7 don’t show up that much.

d) Now colour all the numbers that sum to 7. What do you notice?

There is 3.

b) Describe why it is a pattern. It is a pattern because all of the 5’s are in a line.
Teacher’s Notes

Problem Solving
- The student selects and applies a problem-solving strategy to identify, extend, and create number patterns, arriving at an incomplete or inaccurate solution (e.g., in question 1, shades a pattern, identifies the pattern rule as “I count by 2”, and states that the next number in the pattern “will be 10, 20, 30, 50, 60”).

Understanding of Concepts
- The student demonstrates a limited understanding of patterning in describing a few of the number patterns (e.g., in question 2b, explains how the numbers are arranged by saying, “There arranyed by the odd numbers”).

Application of Mathematical Procedures
- The student extends patterns, making many errors and/or omissions (e.g., in questions 2 and 3, records pattern extensions that are inaccurate).
- The student uses addition and subtraction to generate number patterns, making many errors and/or omissions (e.g., in question 5, records a pattern and states: “4’s going down”).

Communication of Required Knowledge
- The student uses symbols, words, pictures, and/or diagrams with limited clarity in describing patterns and pattern rules (e.g., in question 6, describes the recorded pattern by saying, “it is a pattern because all of the 5’s are in a line”).

Comments/Next Steps
- The student needs to explore a variety of patterns on the hundreds board, using different operations.
- The student needs to use clear mathematical language and notation to describe number patterns.
- The student should explore patterns by using a variety of concrete materials (e.g., pattern blocks, geoboards).
Patterns on the Hundreds Board

1. Find two patterns on the Hundreds Board.

Record your patterns.

Vertically counting by 10^3
Diagonally counting by 10^2
Vertically counting by 10^3

1a) My rule for Pattern A is:

Vertically counting by 10^3

The next number in the pattern would be:

The next number is 101
b) My rule for Pattern B is:

```
diagonally count by 1's
```

The next number in the pattern would be:

```
The next number is 101
```
b) Explain how the numbers are arranged.

I did

c) Can you extend the pattern in another way? Explain your thinking.

add 1's

3. Look for the pattern on the Hundreds Board. Fill in the numbers to 25.

<table>
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<th>2</th>
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</table>

The pattern rule is: to +4, and it is vertically count by 1, 2, 6, 3, 8, 9, 4, 19, 15, 7, 14, 21, 22, 20, 23, 24, 25.
4a) Create a number pattern on the Board below.

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<td>91</td>
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<td>100</td>
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</table>

My pattern rule is: $+4 + 6 + 4 + 6$.

5. Create a different pattern on the Hundreds Board. Colour all the numbers that sum to 6.

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</table>

b) Describe your pattern. A spiral
c) If you were to colour all the numbers that sum to 7, would you be colouring more or fewer numbers? Give reasons for your answer.

If you colour in the ones that sum to 7 there would be more because 7 is a high number.

d) Now colour all the numbers that sum to 7. What do you notice?

all the ones that sum to 7 are one more then the ones that sum to 6

6 a) Make your own pattern on this Hundreds Board.

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<tbody>
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<td>93</td>
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<td>99</td>
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</tbody>
</table>

b) Describe why it is a pattern. It is a diagonal pattern.
c) Ask a question about your pattern you have just created.

what is the next number.

Teacher’s Notes

Problem Solving
- The student selects and applies an appropriate problem-solving strategy to identify, extend, and create number patterns, arriving at a partially complete and/or partially accurate solution (e.g., in question 1, correctly identifies one pattern and incorrectly extends both patterns).

Understanding of Concepts
- The student demonstrates some understanding of patterning in describing some of the number patterns (e.g., in question 1, describes pattern A correctly as “Vertically counting by 10’s”, but describes pattern B incorrectly as “counting by 1’s”).

Application of Mathematical Procedures
- The student extends patterns, making some errors and/or omissions (e.g., in question 3, transposes the 2 and 3 in the first diagonal; in question 2, discontinues the spiral pattern after 13).
- The student uses addition and subtraction to generate number patterns, making some errors and/or omissions (e.g., uses two-step addition [“+ 4 + 6”] to create a number pattern in question 4a, although the layout of numbers does not match his or her pattern rule).

Communication of Required Knowledge
- The student uses symbols, words, pictures, and/or diagrams with some clarity in describing patterns and pattern rules (e.g., uses some mathematics vocabulary to partially describe the patterns in question 5 ("a spiral"), and 6 ("it is a diagonal pattern").

Comments/Next Steps
- The student needs to use clear mathematical language and notation to describe patterns.
- The student should review responses to ensure accuracy.
- The student should continue to explore two-step patterns, placing numbers carefully on the hundreds board.
- The student should refer to word charts or a personal dictionary for correct spellings.
Patterns on the Hundreds Board

1. Find two patterns on the Hundreds Board.

Record your patterns.

My rule for Pattern A is:

My rule for pattern A is that my number is going up by eleven and it is on a diagonal line. This pattern from the ones column is going up by one. This is a growing and shrinking pattern. It goes up by eleven.

The next number in the pattern would be: 111
b) My rule for Pattern B is:
   My rule for pattern B is going up by one and going down by one and it is on a diagonal line. This is a shrinking pattern. It goes up by nine.

   The next number in the pattern would be: 90

2. On this board the numbers are in different places. Look for the pattern. Fill in the numbers. Stop at 25.

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<thead>
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<th>24</th>
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</table>
b) Explain how the numbers are arranged.

The numbers are arranged by 2.
It’s circular.

c) Can you extend the pattern in another way? Explain your thinking.

You can extend the pattern by 1.

3. Look for the pattern on the Hundreds Board. Fill in the numbers to 25.

The pattern rule is: By 2. The other is by 3.

The pattern is vertical.
4a) Create a number pattern on the Board below.

My pattern rule is:
- Goes up by ten.
- Goes down by ten it’s vertical.

5. Create a different pattern on the Hundreds Board. Colour all the numbers that sum to 6.

b) Describe your pattern.

My pattern adds up to six. It’s on a diagonal line.
c) If you were to colour all the numbers that sum to 7, would you be colouring more or fewer numbers? Give reasons for your answer.

You would be colouring 1 more because they would be different because there is 61.

d) Now colour all the numbers that sum to 7. What do you notice?

I noticed that it has 1 more number than the sum 6's.

6 a) Make your own pattern on this Hundreds Board.

b) Describe why it is a pattern.

This is a pattern because it ends by 5 and by 6.
Teacher’s Notes

Problem Solving
- The student selects and applies an appropriate problem-solving strategy to identify, extend, and create number patterns, arriving at a partially complete and/or partially accurate solution (e.g., in question 4a, creates a pattern and gives the rule as “Goes up by ten. Goes down by ten it’s vertical”; in question 5, uses colours and shading to identify sums to 6 and 7 and recognizes the diagonal pattern).

Understanding of Concepts
- The student demonstrates some understanding of patterning in describing some of the number patterns (e.g., in question 1b, describes the pattern as “going up by one and going down by one”, referring to the ones and tens columns, and says, “It goes up by nine”).

Application of Mathematical Procedures
- The student extends patterns, making some errors and/or omissions (e.g., begins a spiral configuration but incorrectly extends it and omits numbers in question 2).
- The student uses addition and subtraction to generate number patterns, making some errors and/or omissions (e.g., has an initial error in the first column of question 3, then uses counting by 3’s).

Communication of Required Knowledge
- The student uses symbols, words, pictures, and/or diagrams with some clarity in describing patterns and pattern rules (e.g., in question 3, part of the description of the rule is clear (“The pattern is vertical”), but part is unclear (“By 2. The other is by 3”); in question 6, the description of the rule is somewhat clear (“… it ends by 5 and by 6”)).

Comments/Next Steps
- The student needs to use clear mathematical language and notation to describe patterns.
- The student should explore a variety of number patterns.

c) Ask a question about your pattern you have just created.

Can my pattern keep going?
1. Find two patterns on the Hundreds Board.

Record your patterns.

1a) My rule for Pattern A is: counting by 3's

The next number in the pattern would be: 10 2
b) My rule for Pattern B is: counting by 45.

The next number in the pattern would be: 104.

2. On this board the numbers are in different places. Look for the pattern. Fill in the numbers: Stop at 25.

```
21 22 25 24 25
20  7  8  9 10
19  6  1  2 11
18  5  4  3 12
17 16 15 14 13
```
b) Explain how the numbers are arranged.
   The numbers are arranged in a square to 25.

c) Can you extend the pattern in another way? I can extend the pattern by making it go around in a square.

3. Look for the pattern on the Hundreds Board. Fill in the numbers to 25.

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</table>

The pattern rule is: counting by ones diagonal.
4a) Create a number pattern on the Board below.

My pattern rule is: **My pattern rule is counting by 3.5.**

5. Create a different pattern on the Hundreds Board. Colour all the numbers that sum to 6.

b) Describe your pattern. **My pattern is counting by 25.**
c) If you were to colour all the numbers that sum to 7, would you be colouring more or fewer numbers? Give reasons for your answer. You would be colouring more 7's because when I was adding more of the numbers added up to 7.

d) Now colour all the numbers that sum to 7. What do you notice? I noticed that I coloured in 1 more 7 than before.

6 a) Make your own pattern on this Hundreds Board.

b) Describe why it is a pattern. It is a pattern because it keeps adding 5.
c) Ask a question about your pattern you have just created.
How many times do you need to add 5’s to get to 100?

Teacher’s Notes

Problem Solving
- The student selects and applies an appropriate problem-solving strategy to identify, extend, and create number patterns, arriving at a generally complete and accurate solution (e.g., in question 1, identifies two different number patterns that have as common terms numbers that can be factored by both 3 and 4 [12, 24, 36, ...]).

Understanding of Concepts
- The student demonstrates a general understanding of patterning in describing many of the number patterns (e.g., describes the pattern in two ways, “conting dy ones” and “diagonal”, in question 3).

Application of Mathematical Procedures
- The student extends patterns, making few errors and/or omissions (e.g., extends the pattern in question 2 and identifies it: “The numer are arranged in a square to 25”).
- The student uses addition and subtraction to generate number patterns, making few errors and/or omissions (e.g., in question 6, describes the pattern by using addition – “it keeps adding 5” – but does not indicate graphically the direction in which the pattern grows).

Communication of Required Knowledge
- The student uses symbols, words, pictures, and/or diagrams clearly in describing patterns and pattern rules (e.g., in question 5, shades numbers that sum to 6 and 7 and states, “You would be colouring more 7’s because when I was adding more of them added up to 7”).

Comments/Next Steps
- The student should discuss more than one attribute when describing patterns (e.g., counting by 3’s and diagonal).
- The student needs to use more detailed mathematical language and notation to describe patterns.
- The student should explore more sophisticated patterns using two-step addition and subtraction or a combination of both.
Patterns on the Hundreds Board  

1. Find two patterns on the Hundreds Board.

Record your patterns.

1 2 3 4 5 6 7 8 9 10
11 12 13 14 15 16 17 18 19 20
21 22 23 24 25 26 27 28 29 30
31 32 33 34 35 36 37 38 39 40
41 42 43 44 45 46 47 48 49 50
51 52 53 54 55 56 57 58 59 60
61 62 63 64 65 66 67 68 69 70
71 72 73 74 75 76 77 78 79 80
81 82 83 84 85 86 87 88 89 90
91 92 93 94 95 96 97 98 99 100

1a) My rule for Pattern A is: diagonally counting by 11's.

\[ \begin{align*}
\text{Starting with } 0 & \quad \text{and adding } 11 \text{ each time.}
\end{align*} \]

The next number in the pattern would be: 101
b) My rule for Pattern B is: diagonally counting by 9, 5
   19
   -10
   ———
   9

The next number in the pattern would be: 102

21 22 23 24 25
20 7 8 9 10
19 6 1 2 11
18 5 4 3 12
17 1 15 14 13
b) Explain how the numbers are arranged. It's arranged in a spiral from the middle out.

c) Can you extend the pattern in another way? Explain your thinking.

extend by odd numbers

3. Look for the pattern on the Hundreds Board. Fill in the numbers to 25.

The pattern rule is: diagonally going left
4a) Create a number pattern on the Board below.

My pattern rule is:
\[ a + 7 + a + 7 \]

5. Create a different pattern on the Hundreds Board. Colour all the numbers that sum to 6.

b) Describe your pattern.

It's a spiral
c) If you were to colour all the numbers that sum to 7, would you be colouring more or fewer numbers? Give reasons for your answer.

Yes, because 7 is higher number than 0 so you go higher then go.

d) Now colour all the numbers that sum to 7. What do you notice?

The X is after the 0.

b) Describe why it is a pattern.

It is counting by 5s.
Teacher’s Notes

Problem Solving
- The student selects and applies an appropriate problem-solving strategy to identify, extend, and create number patterns, arriving at a generally complete and accurate solution (e.g., uses a legend to identify the patterns in question 1).

Understanding of Concepts
- The student demonstrates a general understanding of patterning in describing many of the number patterns (e.g., describes the pattern in question 1b in two ways, “diagonally” and “counting by 9’s”).

Application of Mathematical Procedures
- The student extends patterns, making few errors and/or omissions (e.g., extends the diagonal pattern in question 3, reversing the 2 and the 3).
- The student uses addition and subtraction to generate number patterns, making few errors and/or omissions (e.g., in question 4a, uses two-step addition [+ 2 + 7, including the givens 1 and 10], but makes an addition error [10 + 2 should have been 12], which causes the pattern to be incorrect).

Communication of Required Knowledge
- The student uses symbols, words, pictures, and/or diagrams clearly in describing patterns and pattern rules (e.g., describes the pattern by using three different pieces of information in question 5: the number pattern, a written description, and a picture).

Comments/Next Steps
- The student needs to use more detailed mathematical language and notation to describe patterns.
- The student should explore more sophisticated patterns using two-step addition and subtraction or a combination of both.
- The student should refer to word charts or a personal dictionary for correct spellings.
Patterns on the Hundreds Board

1. Find two patterns on the Hundreds Board.

Record your patterns.

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1a) My rule for Pattern A is:

```
Patter A is diagonally counting by 9's
```

The next number in the pattern would be:

```
The next number would be 100
```
b) My rule for Pattern B is:

Pattern B is vertically counting by 10's.

The next number in the pattern would be:

The next number would be 105.

2. On this board the numbers are in different places. Look for the pattern. Fill in the numbers. Stop at 25.

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b) Explain how the numbers are arranged.

The go in a spiral.

c) Can you extend the pattern in another way? Explain your thinking.

Yes you can. You can put 101 in the center and finish the pattern.

101, 102, 103, 104

3. Look for the pattern on the Hundreds Board. Fill in the numbers to 25.

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The pattern rule is:

Go diagonally to the right.
4a) Create a number pattern on the Board below.

My pattern rule is:

\[ +9 - 1 \]

5. Create a different pattern on the Hundreds Board. Colour all the numbers that sum to 6.

b) Describe your pattern.
c) If you were to colour all the numbers that sum to 7, would you be colouring more or fewer numbers? Give reasons for your answer.

It's not of my numbers sum to 7 or 6 because I did 7 + 2.

d) Now colour all the numbers that sum to 7. What do you notice?

I notice that not one number sums to 7 or 6.

6 a) Make your own pattern on this Hundreds Board.

b) Describe why it is a pattern.

+5 +2
c) Ask a question about your pattern you have just created.

Can you complete my pattern because it is really hard?

Teacher’s Notes

Problem Solving
- The student selects and applies an appropriate problem-solving strategy to identify, extend, and create number patterns, arriving at a thorough and accurate solution (e.g., identifies two different number patterns in question 1).

Understanding of Concepts
- The student demonstrates a thorough understanding of patterning in describing most or all of the number patterns (e.g., uses directional words such as “diagonally counting by 9’s” in question 1a and “The go in a spiral” in question 2b).

Application of Mathematical Procedures
- The student extends patterns accurately (e.g., the diagonal pattern in question 3).
- The student uses addition and subtraction to generate number patterns, making few, if any, minor errors or omissions (e.g., in question 4a, creates a two-step pattern rule that involves both addition and subtraction, misplacing some numbers on the hundreds board).

Communication of Required Knowledge
- The student uses symbols, words, pictures, and/or diagrams clearly and precisely in describing patterns and pattern rules (e.g., in question 1, accurately represents the patterns in the hundreds chart and uses a legend; in question 3, describes the pattern by saying “go diagonally to the right”).

Comments/Next Steps
- The student could try using a variety of strategies (e.g., pictures, diagrams, and charts) to describe number patterns.
- The student could develop even more precise and complete descriptions of pattern rules by taking into account different aspects of the patterns (e.g., starting point, direction, configuration, operation used, calculations).
- The student should refer to word charts or a personal dictionary for correct spellings.
Patterns on the Hundreds Board

1. Find two patterns on the Hundreds Board.

Record your patterns.

1a) My rule for Pattern A is:

\[
\begin{array}{c}
80 \\
- 89 \\
\hline
11
\end{array}
\]

diagonally counting by 115

The next number in the pattern would be:

111
b) My rule for Pattern B is:

\[
\begin{array}{c}
20 \\
10 \\
\hline
10
\end{array}
\]

vertically counting by 10's

The next number in the pattern would be:

110

2. On this board the numbers are in different places. Look for the pattern. Fill in the numbers. Stop at 25.

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b) Explain how the numbers are arranged.

The numbers are in the shape of an X and adding two each time.

c) Can you extend the pattern in another way? Explain your thinking.

Yes, you can make it in to a square.

3. Look for the pattern on the Hundreds Board. Fill in the numbers to 25.

The pattern rule is: diagonally counting by ones.
4a) Create a number pattern on the Board below.

My pattern rule is: 49

5. Create a different pattern on the Hundreds Board. Colour all the numbers that sum to 6.

b) Describe your pattern.

4 + 5, diagonally counting by 9s.
c) If you were to colour all the numbers that sum to 7, would you be colouring more or fewer numbers? Give reasons for your answer.

because none on the pattern equal seven.

d) Now colour all the numbers that sum to 7. What do you notice?

there is none that some to seven.

6 a) Make your own pattern on this Hundreds Board.

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b) Describe why it is a pattern.

double the number
Teacher’s Notes

Problem Solving
- The student selects and applies an appropriate problem-solving strategy to identify, extend, and create number patterns, arriving at a thorough and accurate solution (e.g., in question 1, records the patterns on the hundreds chart by using shading and labels).

Understanding of Concepts
- The student demonstrates a thorough understanding of patterning in describing most or all of the number patterns (e.g., uses directional words such as “diagonally counting by 11’s” and “vertically counting by 10’s” to describe the patterns in questions 1a and 1b).

Application of Mathematical Procedures
- The student extends patterns accurately (e.g., in questions 1, 2, 3, and 4, determines the pattern and continues it; in question 2c, determines an alternative way to extend the pattern).
- The student uses addition and subtraction to generate number patterns, making few, if any, minor errors or omissions (e.g., in question 6, uses multiplication to create a pattern on the hundreds board \(1 \times 2 = 2, 2 \times 2 = 4, 4 \times 2 = 8, 8 \times 2 = 16\), and so forth); in question 6, recognizes that the hundreds chart is not large enough to allow for completing the pattern \(64 \times 2 = 128\)).

Communication of Required Knowledge
- The student uses symbols, words, pictures, and/or diagrams clearly and precisely in describing patterns and pattern rules (e.g., accurately represents and labels the patterns on hundreds charts; represents patterns by using words [e.g., “diagonally counting” and “vertically counting”] and numbers [e.g., “100 – 89 = 11” and “+ 9” and “+ 4 + 5”]).
Comments/Next Steps
- The student should expand the problem-solving strategies used in finding number patterns (e.g., by displaying number patterns in a diagram or chart).
- The student could develop even more precise and complete descriptions of pattern rules by taking into account different aspects of the patterns (e.g., starting point, direction, configuration, operation used, calculations).
- The student should refer to word charts or a personal dictionary for correct spellings.
Title: Patterns on the Hundreds Board

Time Requirements: 145–160 minutes (total)
- 15–20 minutes to complete Pre-task 1
- 15–20 minutes to complete Pre-task 2
- 15–20 minutes to complete Pre-task 3
- 50 minutes to complete questions 1 to 4
- 50 minutes to complete questions 5 to 8

Description of the Task

This task will require students to:
- investigate linear growing and shrinking patterns on different configurations of the hundreds board;
- identify and describe the patterns on the hundreds board;
- explain the pattern rules and extend the patterns.

Students will find different patterns on the hundreds board, record them, state a pattern rule, and extend the pattern to the next number. Then, after examining how some numbers are positioned on hundreds boards, students will fill in other numbers on the boards to create a pattern and explain or describe the pattern or give the pattern rule. On one board, students will colour the numbers that sum to 6 and then to 7, and will discuss what they observed. Finally, students will create their own pattern on a blank hundreds chart, will describe the pattern, and will ask a question about it.

Expectations Addressed in the Exemplar Task

Note that the codes that follow the expectations are from the Ministry of Education’s Curriculum Unit Planner (CD-ROM).

Students will:
1. recognize that patterning results from repetition (3m77);
2. identify, extend, and create linear and non-linear geometric patterns, number and measurement patterns, and patterns in their environment (3m78);
3. identify relationships between and among patterns (3m80);
4. understand patterns in which operations are repeated (e.g., multiplication), transformations are repeated, or multiple changes are made to attributes (3m81);
5. discuss the choice of a pattern rule (3m84);
6. given a rule, extend a pattern and describe it in informal mathematical language (e.g., starting at 3, add 3 to each number to create a pattern) (3m85);
7. use addition and subtraction facts to generate simple patterns in a hundreds chart (3m86).

Teacher Instructions

Prior Knowledge and Skills Required
To complete this task, students should have some knowledge or skills related to the following:
- repeating an operation to make a pattern
- adding, subtracting, and multiplying whole numbers
- exploring multiples on the hundreds board
- recognizing numerical growing and shrinking patterns
- explaining pattern rules
- using a calculator for repeated addition
- recognizing patterns in numbers (e.g., along diagonals)

The Rubric*

The rubric provided with this exemplar task is to be used to assess students’ work. The rubric is based on the achievement chart given on page 9 of The Ontario Curriculum, Grades 1–8: Mathematics, 1997.

Before asking students to do the task outlined in this package, review with them the concept of a rubric. Rephrase the rubric so that students can understand the different levels of achievement.

*The rubric is reproduced on page 106 of this document.
Accommodations
Accommodations that are normally provided in the regular classroom for students with special needs should be provided in the administration of the exemplar task.

Classroom Set-up
For the investigation of the assigned tasks, the following classroom organization is recommended:
• a meeting area for the whole class
• individual workspaces

Materials and Resources Required
Before students attempt a particular task, provide them with the appropriate materials from among the following:
– copies of the student package for each student
– a large hundreds board (magnetic, if possible) and an acetate hundreds board
– copies of a hundreds chart for each student
– centicubes or coloured counters
– pencil crayons
– calculators
– mask template (paper with a cut-out the size of a 4-square grid or cut-outs of other shapes on the hundreds board)
– writing instruments (pencils, erasers)

General Instructions
Setting the Stage
All the student work is to be completed in its entirety at school.

During the pre-task activities, students are to work in a whole class setting so that all can see the overhead, hundreds board, or hundreds chart. Students are to work individually and independently to complete the exemplar task.

Students work as a class to investigate patterns on different hundreds boards. In Pre-task 3, encourage students to arrange the discs on the hundreds board in different ways to form a variety of patterns. After the students have formed an arrangement, have them discuss as many patterns as they can observe on the board.

Centicubes or coloured counters and pencil crayons should be available to all students to use in locating various patterns on the hundreds board before recording them. Calculators may be used for repeated-addition problems.

Posting a Word List
It would be useful to post a chart listing mathematical language that is currently being developed or used during the task. Such a chart will provide the students with a resource to use when communicating their mathematical learning. Words that you may include for this task are: growing pattern, shrinking pattern, vertical, horizontal, spiral, plus, minus.

The Pre-tasks
The pre-tasks are designed to review and reinforce the skills and concepts that students will be using in the exemplar task and to model strategies useful in completing the task.

Task Instructions
Introductory Activities
Pre-task 1: What Patterns Do You See on the Hundreds Board? (15–20 minutes)
This activity works best when there is a hundreds board in the classroom, one that allows the teacher to place and remove discs on it (e.g., a magnetic hundreds board). If such a board is not available, it is suggested that each student be given a blank ten by ten grid on which to write the numbers.

Begin by placing the discs or writing the numbers on the board as shown in Appendix 2. Then ask students questions like the following:
– “What do you see happening?”
– “What number would come next?”
– “What is the patterning rule?”
– “What do you think the visual pattern on the board will look like when the pattern is extended to the bottom of the board? Why?”

There are two separate tasks for students at this stage. The first one is for them to write in some or all of the remaining numbers on the board or chart, or to fill in numbers according to specific prompts (e.g., “Where would 20 be placed on the chart? 30? 54?”). The second task is for students to look for different patterns. For example, discs could be placed on even numbers, odd numbers, and numbers containing a 3 or 6, or on vertical patterns, horizontal patterns, diagonal patterns, addition patterns, patterns on a two by two, patterns on a three by three, and any patterns that involve a combination of operations.

Discuss with the class the patterns they have found. Encourage students to pose some questions of their own. This is a worthwhile task, as it encourages students to think mathematically.
Pre-task 2: Diagonals on a Hundreds Board (15–20 minutes)
Ask the students to look at the numbers in a diagonal on a standard hundreds board and discuss any patterns that they can see. (Note: A diagonal pattern does not have to go from corner to corner.) Encourage students to look for additional patterns by asking questions like the following:
- “What patterns do you see along this diagonal?”
- “Does this pattern always work for all the diagonals? How would you show this?”
- “What happens when you add a number in column one to a number in column two? Where does the sum appear?”
- “What if you now add a number in column three to a number in column five? Where does the sum appear?”

Stress the importance of checking a pattern with several different examples before drawing a conclusion.

Pre-Task 3: Squares on a Hundreds Board (15–20 minutes)
Place a mask template (a piece of paper with a cut-out square window that will reveal four numbers) over an acetate standard hundreds board. Focus the students’ attention on a specific configuration of numbers (e.g., a square).

Students can use a calculator to add and subtract the numbers to find patterns.

Ask:
- “Does this always work?”
- “Would it work with a larger square?”
- “Can you use other shapes to find patterns?”

Exemplar Task (100 minutes)
1. Distribute a copy of the student package to each student.
2. The problem that the students will solve independently is provided in the worksheets in Appendix 1.
Appendix 1: Student Worksheets

Patterns on the Hundreds Board

1. Find two patterns on the Hundreds Board.

Record your patterns.

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1 a) My rule for Pattern A is:

The next number in the pattern would be:
b) My rule for Pattern B is:

The next number in the pattern would be:

2. On this board the numbers are in different places. Look for the pattern. Fill in the numbers. Stop at 25.

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b) Explain how the numbers are arranged.

c) Can you extend the pattern in another way? Explain your thinking.

3. Look for the pattern on the Hundreds Board. Fill in the numbers to 25.

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The pattern rule is:
4  a) Create a number pattern on the Board below.

My pattern rule is:

5. Create a different pattern on the Hundreds Board. Colour all the numbers that sum to 6.

b) Describe your pattern.
c) If you were to colour all the numbers that sum to 7, would you be colouring more or fewer numbers? Give reasons for your answer.

d) Now colour all the numbers to sum to 7. What do you notice?

6 a) Make your own pattern on this Hundreds Board.

b) Describe why it is a pattern.
c) Ask a question about your pattern you have just created.

Appendix 2: What Patterns Do You See on the Hundreds Board?

Pre-task 1

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The Ministry of Education wishes to acknowledge the contribution of the many individuals, groups, and organizations that participated in the development and refinement of this resource document.