Ontario

A Guide to Effective Instruction in Mathematics

Kindergarten to Grade 3

Data Management and Probability

Ontario Education excellence for all

2007

Ontario

A Guide to Effective Instruction in Mathematics

Kindergarten to Grade 3

Data Management and Probability

Every effort has been made in this publication to identify mathematics resources and tools (e.g., manipulatives) in generic terms. In cases where a particular product is used by teachers in schools across Ontario, that product is identified by its trade name, in the interests of clarity. Reference to particular products in no way implies an endorsement of those products by the Ministry of Education.

Ministry of Education

Printed on recycled paper

ISBN 978-1-4249-4587-0

07-015

Contents

Introduction

This document is a practical guide that teachers will find useful in helping students to achieve the curriculum expectations for mathematics outlined in *The Kindergarten Program, 2006* (on pages 47–48, under the subheading "Data Management and Probability") and the expectations outlined in the Data Management and Probability strand for Grades 1 to 3 in *The Ontario Curriculum, Grades 1–8: Mathematics, 2005*. It is a companion document to *A Guide to Effective Instruction in Mathematics, Kindergarten to Grade 6, 2006*.

The expectations outlined in the curriculum documents describe the knowledge and skills that students are expected to acquire by the end of each grade. In *Early Math Strategy: The Report of the Expert Panel on Early Math in Ontario* (Expert Panel on Early Math in Ontario, 2003), effective instruction is identified as critical to the successful learning of mathematical knowledge and skills, and the components of an effective program are described. As part of the process of implementing the panel's vision of effective mathematics instruction for Ontario, *A Guide to Effective Instruction in Mathematics, Kindergarten to Grade 6, 2006* provides a framework for teaching mathematics. This framework includes specific strategies for developing an effective program and for creating a community of learners in which students' mathematical thinking is nurtured. The strategies described in the guide focus on the "big ideas" inherent in the expectations; on problem solving as the main context for mathematical activity; and on communication, especially student talk, as the conduit for sharing and developing mathematical thinking. The guide also provides strategies for assessment, the use of manipulatives, and home connections.

Purpose and Features of the Document

The present document was developed to provide practical applications of the principles and theories behind good instruction that are elaborated in *A Guide to Effective Instruction in Mathematics, Kindergarten to Grade 6, 2006*.

The present document provides:

- an overview of each of the big ideas in the Data Management and Probability strand;
- four appendices (Appendices A–D), one for each grade from Kindergarten to Grade 3, which provide learning activities that introduce, develop, or help to consolidate some aspect of each big idea. These learning activities reflect the instructional practices recommended in *A Guide to Effective Instruction in Mathematics, Kindergarten to Grade 6, 2006*;
- an appendix (Appendix E) that lists the curriculum expectations in the Data Management and Probability strand under the big idea to which they correspond. This clustering of expectations around each of the three big ideas allows teachers to concentrate their programming on the big ideas of the strand while remaining confident that the full range of curriculum expectations is being addressed;
- a glossary that provides definitions of mathematical terms used in this document.

"Big Ideas" in the Curriculum for Kindergarten to Grade 3

In developing a mathematics program, it is vital to concentrate on important mathematical concepts, or "big ideas", and the knowledge and skills that go with those concepts. Programs that are organized around big ideas and focus on problem solving provide cohesive learning opportunities that allow students to explore concepts in depth.

> All learning, especially new learning, should be embedded in well-chosen contexts for learning – that is, contexts that are broad enough to allow students to investigate initial understandings, identify and develop relevant supporting skills, and gain experience with varied and interesting applications of the new knowledge. Such rich contexts for learning open the door for students to see the "big ideas", or key principles, of mathematics, such as pattern or relationship. (Ontario Ministry of Education, 2005, p. 25)

Students are better able to see the connections in mathematics, and thus to *learn* mathematics, when it is organized in big, coherent "chunks". In organizing a mathematics program, teachers should concentrate on the big ideas in

mathematics and view the expectations in the curriculum policy documents for Kindergarten and Grades 1 to 3 as being clustered around those big ideas.

The clustering of expectations around big ideas provides a focus for student learning and for teacher professional development in mathematics. Teachers will find that investigating and discussing effective teaching strategies for a big idea is much more valuable than trying to determine specific strategies and approaches to help students achieve individual expectations. In fact, using big ideas as a focus helps teachers to see that the concepts represented in the curriculum expectations should not be taught as isolated bits of information but rather as a network of interrelated concepts.

In building a program, teachers need a sound understanding of the key mathematical concepts for their students' grade level and a grasp of how those concepts connect with students' prior and future learning (Ma, 1999). They need to understand the "conceptual structure and basic attitudes of mathematics inherent in the elementary curriculum" (p. xxiv) and to know how best to teach the concepts to students. Concentrating on developing this knowledge and understanding will enhance effective teaching.

Focusing on the big ideas provides teachers with a global view of the concepts represented in the strand. The big ideas also act as a "lens" for:

- making instructional decisions (e.g., choosing an emphasis for a lesson or set of lessons);
- identifying prior learning;
- looking at students' thinking and understanding in relation to the mathematical concepts addressed in the curriculum (e.g., making note of the ways in which a student uses a game strategy based on his or her understanding of probability);
- collecting observations and making anecdotal records;
- providing feedback to students;
- determining next steps;
- communicating concepts and providing feedback on students' achievement to parents[1] (e.g., in report card comments).

Teachers are encouraged to focus their instruction on the big ideas of mathematics. By clustering expectations around a few big ideas, teachers can teach for depth of understanding. This document provides models for clustering the expectations around a few major concepts and includes activities that foster understanding of the big ideas in Data Management and Probability. Teachers can use these models in developing other lessons in Data Management and Probability, as well as lessons in other strands of mathematics.

---

1. In this document, *parent(s)* refers to parent(s) and guardian(s).

The Big Ideas in Data Management and Probability

The related topics of data management and probability are highly relevant to everyday life. Graphs and statistics bombard the public in advertising, opinion polls, population trends, reliability estimates, descriptions of discoveries by scientists, and estimates of health risks, to name just a few…. Connecting probability to data management to real-world problems helps make the learning relevant to students.

(Ontario Ministry of Education, 2005, pp. 9–10)

Overview

The tremendous growth of electronic technology in the past decade has facilitated the ways in which information is gathered, analysed, interpreted, and communicated. Increasingly, decisions that affect people's daily lives are driven by data. Because of the growing importance of data in society, the study of data management and probability now receives increased emphasis in the mathematics program.

This section focuses on the three big ideas that form the basis of the curriculum expectations in Data Management and Probability for Kindergarten to Grade 3. An understanding of these big ideas assists teachers in providing instructional and assessment opportunities that promote student learning of important concepts in Data Management and Probability.

The big ideas or major concepts in Data Management and Probability are the following:

- collection and organization of data
- data relationships
- probability

Teachers should recognize that these big ideas are conceptually related and interdependent, and that many instructional experiences reflect more than one of the big ideas. In many learning activities, students collect and organize data, and then examine data relationships within the data they gathered.

The discussion of each big idea in this section contains:

- an **overview**, which includes a general discussion of the development of the big idea in the primary grades, an explanation of some of the key concepts inherent in the big idea, and in some instances additional background information on the concept for the teacher;
- **grade-specific descriptions** of (1) characteristics of learning evident in students who have been introduced to the concepts addressed in the big idea, and (2) instructional strategies that will support those learning characteristics. In order to address a range of student learning needs, teachers should examine instructional strategies for grade levels other than their own.

General Principles of Instruction

The following principles of instruction are relevant in teaching Data Management and Probability in the primary grades:

- **Student talk is important.** Students need to talk about and talk through mathematical concepts, with one another and with the teacher.
- **Representations of concepts promote understanding and communication.** In Data Management and Probability, concepts can be represented in various ways (e.g., through the use of manipulatives, diagrams, graphs). Teachers need to help students make connections between different representations of a mathematical concept (e.g., by showing them how the same information can be represented in a concrete graph and a bar graph).
- **Students learn through problem solving.** Problem-solving situations provide students with a context and a meaningful purpose for reasoning about mathematical concepts and ideas. As well, organizing learning activities within a three-part lesson based on problem solving prompts students to engage in a problem-solving process of learning mathematics. The main parts of the three-part lesson structure recommended in *A Guide to Effective Instruction in Mathematics, Kindergarten to Grade 6, 2006* are Getting Started, Working on It, and Reflecting and Connecting. For examples of the three-part lesson structure, see the learning activities in this guide.
- **Students need frequent experiences using a variety of learning strategies (e.g., investigations, problem-solving activities, games) and resources (e.g., interlocking cubes, graph templates, software programs).** Teachers should use a variety of learning strategies in instruction to address the learning styles of all students.

- **Teachers can help students acquire mathematical language by using correct mathematical vocabulary themselves.** Beginning in Kindergarten, teachers should model appropriate mathematical terminology and encourage students to use mathematical vocabulary that will allow them to express themselves clearly and precisely.

Working Towards Equitable Outcomes for Diverse Students

All students, whatever their socio-economic, ethnocultural, or linguistic background, must have opportunities to learn and to grow, both cognitively and socially. When students can make personal connections to their learning, and when they feel secure in their learning environment, their true capacity will be reflected in their achievement. A commitment to equity and inclusive instruction in Ontario classrooms is therefore critical to enabling all students to succeed in school and, consequently, to become productive and contributing members of society.

To create effective conditions for learning, teachers must take care to avoid all forms of bias and stereotyping in resources and learning activities, which can quickly alienate students and limit their learning. Teachers should be aware of the need to provide a variety of experiences and to encourage multiple perspectives, so that the diversity of the class is recognized and all students feel respected and valued. Learning activities and resources for teaching mathematics should be inclusive, providing examples and illustrations and using approaches that recognize the range of experiences of students with diverse backgrounds, knowledge, skills, interests, and learning styles.

The following are some strategies for creating a learning environment that acknowledges and values the diversity of students, and enables them to participate fully in the learning experience:

- providing mathematics problems with situations and contexts that are meaningful to all students (e.g., problems that reflect students' interests, home-life experiences, and cultural backgrounds and that stimulate their curiosity and spirit of enquiry);
- using mathematics examples drawn from diverse cultures, including those of Aboriginal peoples;
- using children's literature that reflects various cultures and customs as a source of mathematics examples and situations;

- understanding and acknowledging customs and adjusting teaching strategies, as necessary. For example, a student may come from a culture in which it is considered inappropriate for a child to ask for help, express opinions openly, or make direct eye contact with an adult;
- considering the appropriateness of references to holidays, celebrations, and traditions;
- providing clarification if the context of a learning activity is unfamiliar to students (e.g., describing or showing a food item that may be new to some students);
- evaluating the content of mathematics textbooks, children's literature, and supplementary materials for cultural or gender bias;
- designing learning and assessment activities that allow students with various learning styles (e.g., auditory, visual, tactile/kinaesthetic) to participate meaningfully;
- providing opportunities for students to work both independently and interdependently with others;
- providing opportunities for students to communicate orally and in writing in their home language (e.g., pairing English language learners with a first-language peer who also speaks English);
- using diagrams, pictures, manipulatives, sounds, and gestures to clarify mathematical vocabulary that may be new to English language learners.

For a full discussion of equity and diversity in the classroom, as well as a detailed checklist for providing inclusive mathematics instruction, see pages 34–40 in Volume 1 of *A Guide to Effective Instruction in Mathematics, Kindergarten to Grade 6, 2006*.

Collection and Organization of Data

Because young children are naturally curious about their world, they often raise questions such as, How many? How much? What kind? or Which of these? Such questions often offer opportunities for beginning the study of data analysis and probability.

(National Council of Teachers of Mathematics, 2000, p. 49)

Overview

The main purpose for collecting and organizing data is to gather information in order to answer questions. When students collect and organize data, they have an opportunity to learn more about themselves, their environment, issues in their school or community, topics in various subject areas, and so on. Learning activities should help students understand the processes that are involved in formulating questions, seeking relevant information, and organizing that information in meaningful ways.

Involving students in collecting and organizing data allows them to participate in the decision making that is required at different steps of the process. The following chart outlines some questions for decision making associated with the steps in collecting and organizing data.

Step	Questions for Decision Making
Formulating a question	• What do we need to find out? • What question needs to be answered? • What kind of data needs to be gathered in order to answer the question?
Collecting data	• Where and from whom will data be collected? • How will data be gathered (e.g., conducting a survey, taking a poll, conducting an experiment)? • How will data be recorded?
Organizing data	• How can the data be organized so that they provide an answer to the question? • What type of graphical representation(s) can effectively present the data?

During learning activities, teachers should involve students in making decisions about collecting and organizing data by asking them questions, such as those outlined above. As students' understanding of data-collection processes grows, they become able to consider these questions and make appropriate decisions on their own.

The following are key points that can be made about collecting and organizing data in the primary grades:

- The main purpose for collecting and organizing data is to answer questions.
- Early experiences in sorting and classifying objects help students understand how data can be organized.
- Organizing data in graphs, tables, charts, and other graphic organizers helps students make sense of the data.
- Various kinds of graphs display data and communicate information in different ways.

Collecting and organizing data to answer questions

Questions that interest students provide the impetus for collecting and organizing data in the primary grades. When questions stimulate students' curiosity, they become engaged in collecting, organizing, and interpreting the data that provide answers to their inquiries. Relevant questions often arise from class discussions; classroom events, issues, and thematic activities; and topics in various subject areas. The following are questions that might be used in the classroom for collecting and organizing data:

Questions about students

- "How did you get to school today?"
- "What is your eye colour? hair colour? height?"
- "How many pockets (buttons, zippers) are on your clothes?"
- "Can you whistle? tie your shoelaces? snap your fingers?"
- "How many people are in your family?"
- "What pets do you have?"

Questions about feelings and opinions

- "What is your favourite television show? colour? fruit?"
- "How do you feel about rainy days? indoor recess?"
- "What do you like to do at recess? after school? on the weekend?"
- "Which story (game, activity) did you like the best?"

Questions about the environment

- "What kinds of materials are in our classroom garbage?"
- "How much did your bean plant grow in the last week?"
- "What was the weather like in March?"

Once a question has been identified, students need to collect data that will answer that question. In the primary grades, data are often collected from the whole class, using various simple methods. (See examples of simple methods for collecting data on the next two pages.) These simple methods emphasize important ideas about data collection:

- There is a one-to-one correspondence between each item (e.g., cube, sticky note, picture symbol) in the graph and each student.
- By organizing data into categories, it is possible to compare the quantities in different categories on a graph.
- Individuals collectively contribute to the creation of a set of data.

Whole-class experiences in collecting data help students understand how they might collect data, as a small group or individually. It is beneficial to have students collect the information themselves (primary data) rather than simply refer to artificial sets of data or to information that has been gathered by others (secondary data). The task of collecting data requires students to plan how they will gather data (e.g., using a survey, conducting an experiment, making observations) and how they can organize data (e.g., placing sticky notes in a chart, making a tally, creating a line plot).

In the primary grades, data collection often involves conducting a survey. When students plan and carry out surveys, they take ownership for identifying a survey question, learning efficient ways to collect and record the data, and organizing the data in different ways to make sense of them. The amount of support (e.g., questioning, modelling, scaffolding) teachers provide to students as they plan and conduct surveys depends on students' understanding of and experiences with the processes involved, and on their skills in using these processes independently. It can be detrimental to teach data-collection methods as rote processes – for example, by giving all students the same survey question and a class list, having students ask everyone the question, and telling them to record "yes" or "no" after each name. Such an approach provides little opportunity for students to think critically or to make decisions about such questions as the following:

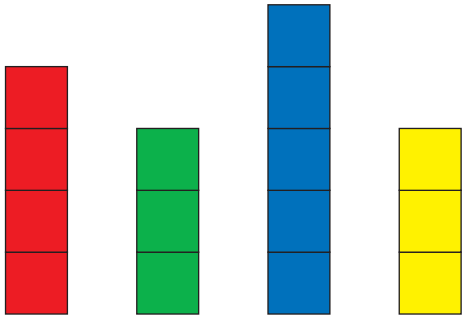
- "Who will answer the survey question?"
- "How many people will answer the survey question?"

- "How can we record responses to the survey question?"
- "How can we keep track of who has and has not answered the survey question?"
- "How will we organize the data that we collect?"

Simple Methods for Collecting Data

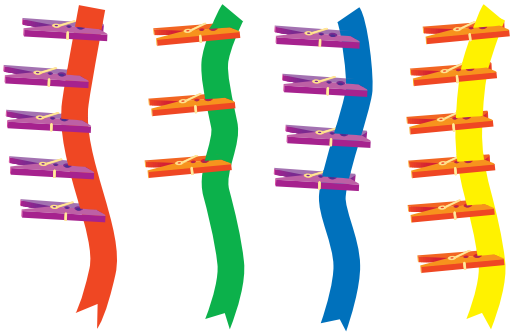
In the early primary grades, students participate in data-collection activities that often involve all members of the class. A variety of simple materials can be used to collect and organize data.

Favourite Colours



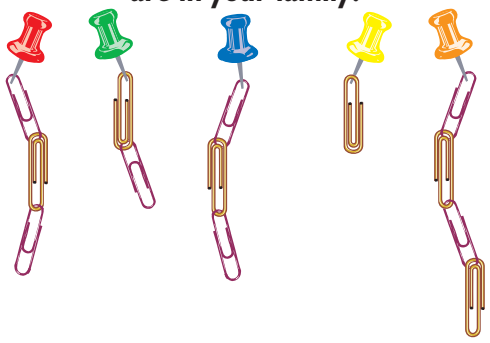
Simple bar graphs can be created using sticky notes.

Favourite Pets



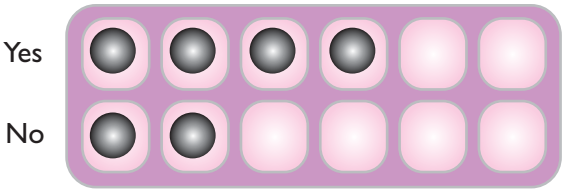
Students can attach clothespins to pieces of ribbon.

How many people are in your family?



Data can be represented using paper clips or links.

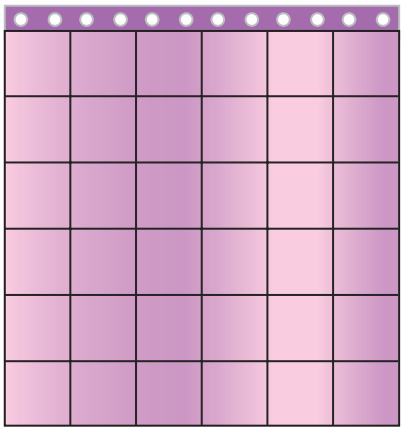
Did you like the game?



Students can collect and organize data by placing counters in an ice cube tray or an empty egg carton.

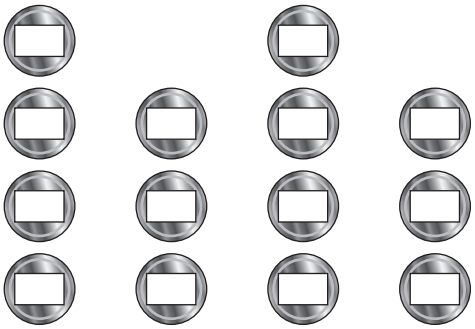
continued

Simple Methods for Collecting Data



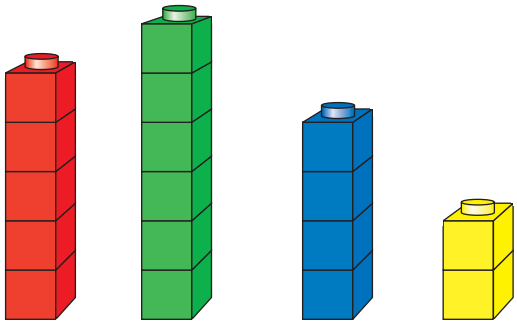
A graphing mat can be made using a plastic shower curtain. Grid lines can be created using electrical tape. Students categorize objects or pictures by placing them in the columns of the graph mat.

Favourite Flavour of Juice



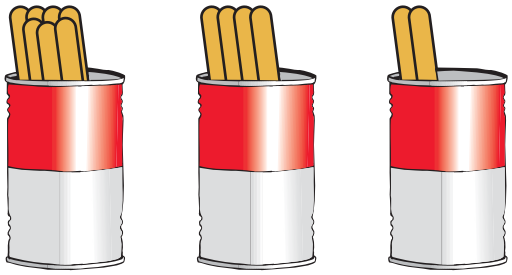
Students' nametags or photographs can be glued to the lids of frozen juice containers. Magnetic tape attached to the back of the lids allows students to arrange their nametags or photographs in graphs on a magnetic board.

Favourite Flavour of Ice Cream



Students can collect data using interlocking cubes. Later, they can arrange the cubes into columns to create a concrete bar graph.

Ways I Play in Winter



Students can collect and organize data by placing craft sticks into empty cans.

Data collected by students can be categorical or discrete. "Categorical data" are data that can be sorted by type or quality. For example, if students conduct a survey to find in which months classmates have birthdays, responses to the survey provide categorical data that can be sorted according to the months of the year. "Discrete data" are data that involve numerical values. Discrete data often represent things that can be counted. For example, students might collect data about the number of books read by classmates in a week. In this case, the data are discrete – they involve numerical values (i.e., the number of books). Generally, students in Kindergarten and Grade 1 collect categorical data, while students in Grades 2 and 3 collect both categorical and discrete data.

Sorting and classifying

Before children begin school, they construct ideas about organizing things when they sort and classify objects, such as play materials. Sorting involves examining objects, identifying similar attributes (e.g., colour, size, shape), and organizing objects that "go together" into groups. Along with learning to sort, children learn to classify, that is, to identify a common characteristic of all items within a group. Because experiences in sorting help children to develop critical mathematical skills (e.g., observing, analysing, comparing), it is essential that teachers provide many opportunities for students to sort and classify a variety of objects, including found materials (e.g., buttons, lids, and other objects in their local environment) and manipulatives (e.g., attribute blocks, pattern blocks, geometric solids).

Children progress through different levels of sorting and classifying (Copley, 2000):

- Initially, children separate objects that share a common characteristic from a collection (e.g., separating all the red beads from a collection of beads). They do not always apply one sorting rule consistently and may go on to separate objects according to a different attribute (e.g., creating another pile of all the shiny beads).
- At the second level, children are able to sort an entire collection of objects according to one attribute. They often sort objects into two groups – those that have a certain attribute, and those that do not (e.g., creating a group of white beads and a group of beads that are not white).
- At the third level, children are able to sort a collection of objects in more than one way (e.g., colour *and* size, or shape *and* texture). Children can explain how they sorted the objects, but they may have difficulty understanding how others sorted objects.
- At the highest level, children are able to state the rule used for sorting objects, even when the objects are sorted by someone else. To do this, children need to observe the common attribute(s) shared by all the objects in a group, and determine that objects in other groups do not share these attribute(s).

Students progress in their sorting skills when they are encouraged to find different ways to sort a variety of materials, when they observe how others sort materials, and when they reflect on different ways to sort materials. Teachers can help students develop sorting skills by asking questions, such as the following:

- "How did you sort these objects?"
- "How are these objects alike? How are these objects different?"
- "Why does this object belong here? Why does it not belong here?"
- "Which other objects belong in this group?"
- "What name could you give to this group?"
- "How could you sort these objects in a different way?"
- "How did Anhil sort the objects?"

Experiences in sorting and classifying objects prepare students for organizing data by helping them understand that things (including data) can be categorized based on common characteristics. The decision making and reasoning that are developed as students sort and classify objects continue to be important mental processes when students learn to organize data.

Organizing data in graphs, charts, and tables

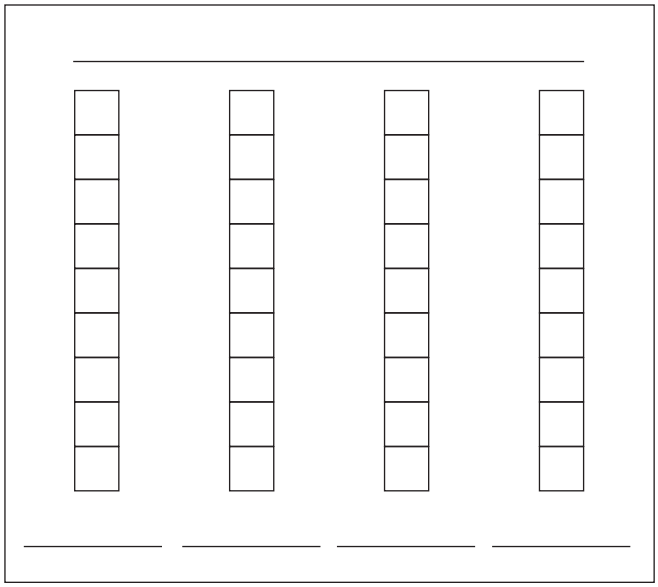
Organizing data helps to reveal information that would not be apparent if the data were randomly arranged. By organizing data into groups or categories, it is easier to interpret information and notice relationships, trends, and patterns. Information that is revealed in organized data often provides the answers to the questions that prompted the collection of the data.

Organizing data in graphs: The skills and concepts that students develop through experiences in sorting objects help them understand how data can be organized in graphs. Students learn that data, like objects, can be sorted into groups and categories.

In the early primary grades, students organize data directly into graphs while collecting the data. Often, the entire class participates in organizing data, using the following types of graphs:

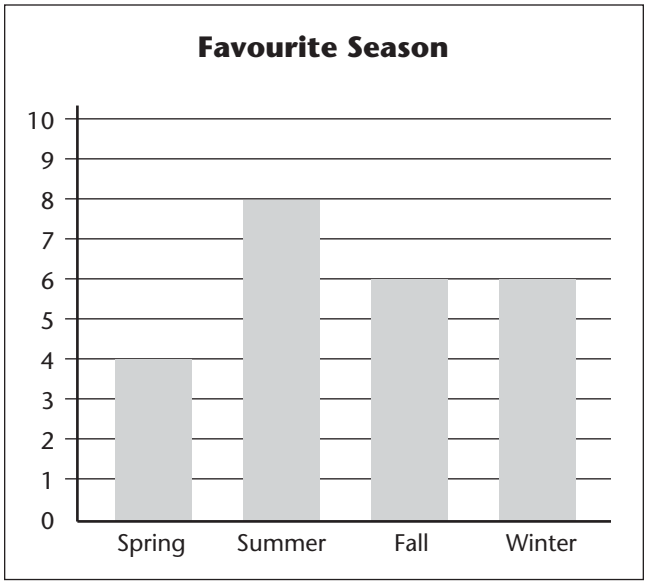
- **People graph:** Students themselves represent the data in a people graph. They organize themselves into rows according to the categories in the graph. Students examine the length of the rows in order to compare the data in different categories.
- **Concrete graph:** In a concrete graph, objects are used to represent the data. Each object is placed on a graph template (e.g., a graphing mat) so that students can easily count and compare the number of items in different categories.
- **Pictograph:** Pictures or symbols are used to represent the data in pictographs.

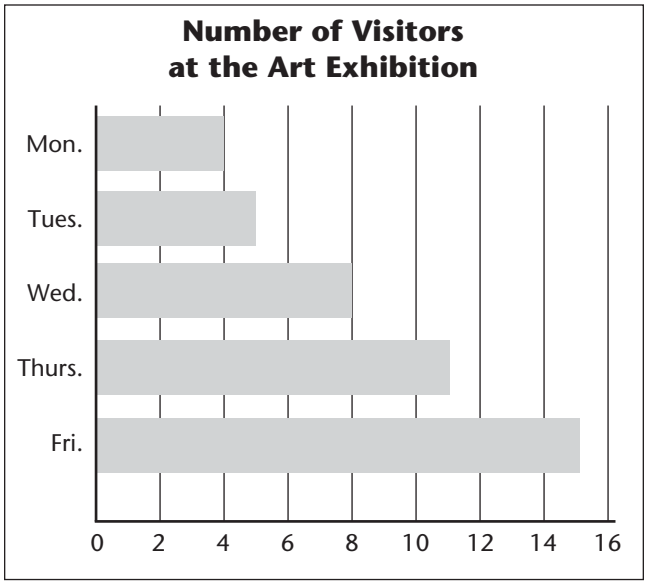
As students develop skill and independence in gathering data, teachers can provide templates that allow students to organize the data they collect.



Later, students learn how to organize data in graphs they create themselves. They also discover the value of using collection techniques, such as tallying, before beginning to construct graphs to organize the data. In the later primary grades, students construct vertical and horizontal bar graphs, and line plots.

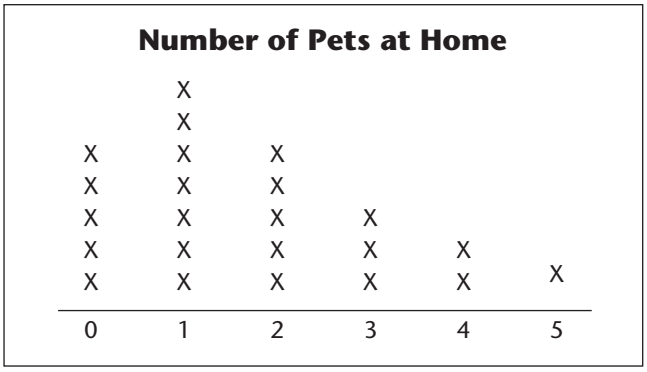
Examples of Bar Graphs





Bar graphs consist of horizontal or vertical bars that represent the things being counted in the graph. A scale can help to show the number of items represented by each bar.

Example of a Line Plot



Line plots show counts of things along a numeric scale. Each mark (often an "X") represents a piece of data. Line plots provide a quick way to examine the shape of the data (e.g., where most of the data occur).

Organizing data in charts and tables: In the primary grades, students learn that information can be organized in charts. As the following examples show, charts may or may not contain numeric data.

Keeping Our Classroom Tidy!	
Bookshelves	Red Group
Coat rack	Blue Group
Math bins	Yellow Group
Learning centres	Green Group

Heights of African Animals	
Giraffe	5 metres
Elephant	4 metres
Zebra	1 1/2 metres
Rhinoceros	2 metres

Tally charts are particularly useful for gathering and organizing data.

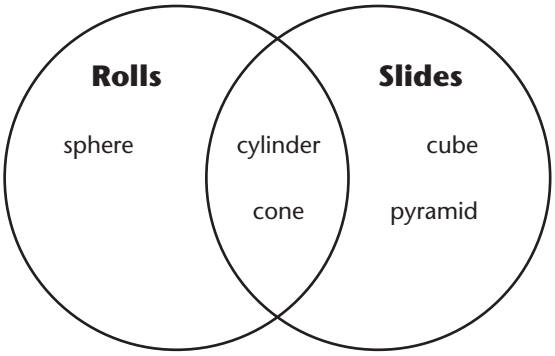
How Do You Get to School?	
Walk	𝍸 ||||
Car	𝍸 |
Bus	𝍸 𝍸

Tables often display data that are arranged in a systematic or an ordered way.

Admission Costs	
Number of People	**Cost**
1	$1.20
2	$2.40
3	$3.60
4	$4.80

Organizing data in other graphic organizers: Students can use various other graphic organizers to display data. Commonly used graphic organizers in the primary grades include Venn diagrams, Carroll diagrams, and glyphs.

Venn Diagram



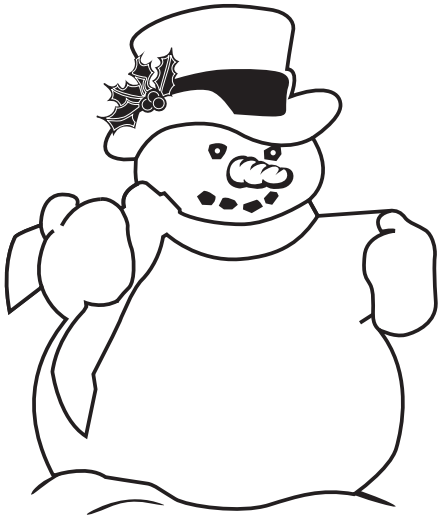
A Venn diagram consists of overlapping or nested shapes used to show what two or more sets have and do not have in common.

Carroll Diagram

	Mammal	Not a Mammal
Has Four Legs	horse elephant	frog toad
Does Not Have Four Legs	whale seal	duck trout

A Carroll diagram displays yes/no categorical data in a chart form.

Glyph



Key for Snowman Glyph

Red hat – you are a boy
Green hat – you are a girl
Yellow scarf – you like winter
Blue scarf – you do not like winter
Holding a skate – you can skate
Standing on a toboggan – you like to toboggan
Snowflake on the body of the snowman – you like to play in the snow

A glyph is a pictorial display in which colours and/or symbols represent information. A key provides instructions to students on how to complete their glyphs.

Graphs as a means for displaying data and communicating information

Well-constructed graphs provide an effective means for communicating information to others. Learning opportunities should help students not only to create graphs but also to develop their understanding of how graphs contain and communicate information.

As students gain experience in creating various kinds of graphs, they develop an understanding of how the structures of different graphs allow certain kinds of information to be emphasized. For example, they observe that concrete graphs, pictographs, and bar graphs allow for easy and quick comparisons of quantities represented in the graph.

Students also learn that the title, labels, symbols, and scales are important components that help to communicate information in a graph:

- The title introduces the data contained in the graph.
- Labels identify the categories or numeric values into which data are categorized.
- In pictographs, symbols (e.g., pictures, icons) represent the data. Each symbol can represent one piece of data (one-to-one correspondence) or more than one piece of data (many-to-one correspondence).
- Scales identify the numeric values along an axis of a graph.

Teachers should provide opportunities for students to make decisions about how they can most effectively display the data they collect. They should encourage students to determine what information is important to represent and to select a type of graph that will best communicate that information. When the emphasis is on effective communication, rather than on simply following graphing conventions, students must think about how others will read and interpret their graphs.

Technology allows students to create different kinds of graphs, without the tedious and time-consuming work required to construct hand-drawn graphs. For example, in the primary grades, students can use Graphers (Ministry-licensed software) to:

- create a set of data and display it in different ways;
- sort a set of data manually;
- select different ways to display a data set;
- sort sets using two or three attributes;
- create graph and diagrams using data they have collected;
- display the same set of data using a variety of graphs (e.g., pictographs, bar graph, Venn diagrams, circle graphs).

Characteristics of Student Learning and Instructional Strategies by Grade

Kindergarten

Characteristics of Student Learning

In general, students in Kindergarten:

- describe similarities and differences between objects;
- sort objects using obvious attributes (e.g., colour, size, shape). Students might sort objects into two groups – those that have a certain attribute, and those that do not (e.g., creating a group of white buttons and a group of buttons that are not white), or they might sort objects according to a general criterion, such as colour (e.g., one group of white buttons, one group of black buttons, and one group of red buttons);
- begin to explore ways to sort objects using less obvious attributes (e.g., texture, mass, thickness);
- explain their rules for sorting objects;
- are curious, and pose questions about themselves and their environment;
- collect data to answer questions, with guidance from the teacher.

Instructional Strategies

Students in Kindergarten benefit from the following instructional strategies:

- providing opportunities to sort the same collection of objects in a variety of ways;
- discussing ways to sort objects using obvious attributes (e.g., colour, size shape), and encouraging students to sort objects using less obvious attributes (e.g., texture, mass, thickness);
- having students generate questions that can be answered using simple methods for collecting data (e.g., by placing stickers on a graph);
- providing opportunities to create and discuss people graphs, concrete graphs, and pictographs;
- providing graphing mats to help students organize data in people graphs and concrete graphs;
- having students conduct surveys involving questions that have a limited number of responses (e.g., "How many people are in your family?");
- discussing and demonstrating different data-collection methods (e.g., placing a picture in the appropriate section of a pictograph, making a tally);

- providing opportunities for students to vote in order to make class decisions (e.g., by showing raised hands, by putting check marks on a chart, by placing cubes in bowls that are labelled with possible choices).

Grade 1

Characteristics of Student Learning

In general, students in Grade 1:

- compare objects by describing how they are similar and/or different;
- sort and classify objects using obvious attributes (e.g., colour, size, shape) and less obvious attributes (e.g., texture, mass, thickness);
- explain their rules for sorting objects;
- generate survey questions about themselves and their environment;
- conduct surveys to collect data;
- devise their own methods for collecting data (e.g., making a list of all classmates' names and their choices), although their techniques may be inefficient;
- collect data using methods that have been demonstrated by teachers or other students (e.g., making tally charts);
- collect and display categorical data (i.e., data that can be organized into categories) using prepared graph templates.

Instructional Strategies

Students in Grade 1 benefit from the following instructional strategies:

- providing opportunities to sort the same collection of objects in a variety of ways;
- discussing ways to sort objects using obvious attributes (e.g., colour, size shape), and encouraging students to sort objects using less obvious attributes (e.g., texture, mass, thickness);
- asking students to explain how they sorted a collection of objects;
- playing games in which students determine a "secret" rule that was used to sort a collection of objects;
- having students generate questions about their classmates that can be answered using simple methods for collecting data;
- providing opportunities to create and discuss people graphs, concrete graphs, and pictographs;
- providing graphing mats to help students organize data in people graphs, concrete graphs, and pictographs;

- having students create graphs using prepared graph templates;
- having them design and conduct simple surveys involving questions that have a limited number of possible responses;
- discussing and demonstrating different methods for collecting data (e.g., placing a sticky note in the appropriate section of a graph, making a tally);
- providing opportunities for students to vote in order to make class decisions (e.g., by showing raised hands, by putting check marks in a chart, by placing cubes in bowls that are labelled with possible choices).

Grade 2

Characteristics of Student Learning

In general, students in Grade 2:

- sort and classify objects using two attributes simultaneously (e.g., sort marbles by colour *and* size at the same time);
- explain their rules for sorting objects;
- generate survey questions about themselves and their environment;
- conduct surveys to collect data;
- collect and record data using various methods (e.g., using line plots, making tally charts);
- construct concrete graphs, pictographs, and simple bar graphs to represent data using one-to-one correspondence;
- include titles, labels, and symbols in graphs, and explain the importance and function of these graph components.

Instructional Strategies

Students in Grade 2 benefit from the following instructional strategies:

- providing opportunities to sort and classify objects using two attributes simultaneously;
- providing opportunities to sort and classify objects using Venn diagrams, and discussing how objects can belong to more than one category;
- asking students to explain how they sorted a collection of objects;
- playing games in which students determine a "secret" rule that was used to sort a collection of objects;
- having students design and conduct surveys involving questions that have a limited number of responses;

- having students collect and organize data that are categorical (i.e., that can be organized into topic categories) or discrete (i.e., that can be counted and represented by a number);
- discussing and demonstrating different methods for collecting data (e.g., using a line plot, making a tally);
- providing opportunities to create concrete graphs, pictographs, and simple bar graphs, and discussing how the different graphs can be used to organize and display data;
- providing opportunities to create graphs and graphic displays, using software programs (e.g., Graphers);
- discussing how data in tally charts can be represented in bar graphs;
- discussing the importance and function of titles, labels, and symbols in graphs.

Grade 3

Characteristics of Student Learning

In general, students in Grade 3:

- sort and classify objects using two or more attributes simultaneously (e.g., sort pebbles by colour, size, *and* texture at the same time);
- explain their rules for sorting objects;
- design and conduct surveys to collect data;
- collect, organize, and record data using various methods (e.g., using line plots, making tally charts);
- construct tables, charts, pictographs, and horizontal and vertical bar graphs to display data;
- understand the importance and function of titles, labels, symbols, and scales in graphs.

Instructional Strategies

Students in Grade 3 benefit from the following instructional strategies:

- providing opportunities to sort and classify objects using two or more attributes simultaneously;
- providing opportunities to sort and classify objects using Venn diagrams, and discussing how objects can belong to more than one category;
- asking students to explain how they sorted a collection of objects;
- having students design and conduct surveys about themselves, their environment, issues in their school or community, or topics in various subject areas;

- having students collect and organize data that are categorical (i.e., that can be organized into topic categories) or discrete (i.e., that can be counted and represented by a number);
- discussing and demonstrating different methods for collecting, organizing, and recording data (e.g., using a line plot, making a tally);
- providing opportunities to create charts, tables, and graphs (e.g., pictographs, horizontal and vertical bar graphs), and discussing how they can be used to organize and display data;
- providing opportunities to create graphs and graphic displays, using software programs (e.g., Graphers);
- discussing how data in tally charts can be represented in bar graphs;
- discussing many-to-one correspondence in pictographs and bar graphs (e.g., in a bar graph, one square represents two students);
- discussing the importance and function of titles, labels, symbols, and scales in graphs.

Data Relationships

Overview

Reading data in a chart, table, or graph involves looking at relationships within the particular display of data. For data to be meaningful, it is necessary to understand the relationship between the data and the context of the graphic display in which they appear. For example, the number 12 in the following tally chart has little meaning unless it can be connected to the purpose of the chart (i.e., 12 students chose playing in the snow as their favourite winter activity). It is also necessary to recognize the relationships between pieces of data, in order to interpret the significance of the data. It is impossible to know whether most students chose playing in the snow as their favourite activity, without comparing 12 with the number of students who chose other activities.

Favourite Winter Activities		
Playing in the snow	𝍸 𝍸 ||	12
Skating	𝍸 |	6
Tobogganing	𝍸 𝍸	10

The following are key points that can be made about data relationships in the primary grades:

- Reading data involves different levels of comprehension.
- Analysing data provides a sense of the shape of the data, including how the data are spread out, grouped, and centred.

Levels of comprehension in reading data

The focus in Data Management and Probability should not be only on the construction of graphs; students also need opportunities to examine and describe information in their own graphs and in graphs created by others. In the early

primary grades, teachers ask questions that help students to think about information presented in graphs, and to consider how this information provides answers to the question that prompted the creation of the graph. In later grades, students develop more independence in examining and describing information in graphs.

Curcio (2001) identifies three levels of graph comprehension:

- **Reading the data** involves finding information that is explicitly stated in the graph. No interpretation of the data is required.
- **Reading between the data** involves interpreting mathematical relationships expressed in the graph. It requires the ability to compare quantities (e.g., most, greater, fewest) and to apply other mathematical concepts and skills (e.g., addition, subtraction).
- **Reading beyond the data** involves making inferences about the data. It requires the student to apply background knowledge to interpret information that is not explicitly stated in the graph.

These three levels reflect the development of students' ability to read graphs. Students in the early primary grades are able to find apparent information in graphs (reading the data). As students gain more experience with graphs, they develop skill in seeing relationships between pieces of data (reading between the data), and, eventually, in making inferences about the data (reading beyond the data).

The following chart provides sample questions that encourage students to read graphs at the three levels of graph comprehension.

Reading the Data

- "What is the favourite kind of fruit in our class?"
- "How many books did our class read this month?"
- "How many students in our class were born in September?"

Reading Between the Data

- "How many more students like apples than like bananas?"
- "In which month did our class read the fewest books?"
- "How many more students were born in September than in December?"

Reading Beyond the Data

- "Why do you think the fewest students chose 'lemon' as their favourite fruit?"
- "If our class continues to read approximately the same number of books each month, how many books will we have read by the end of June?"
- "What might a graph of birthday months look like for Mrs. Fraser's class?"

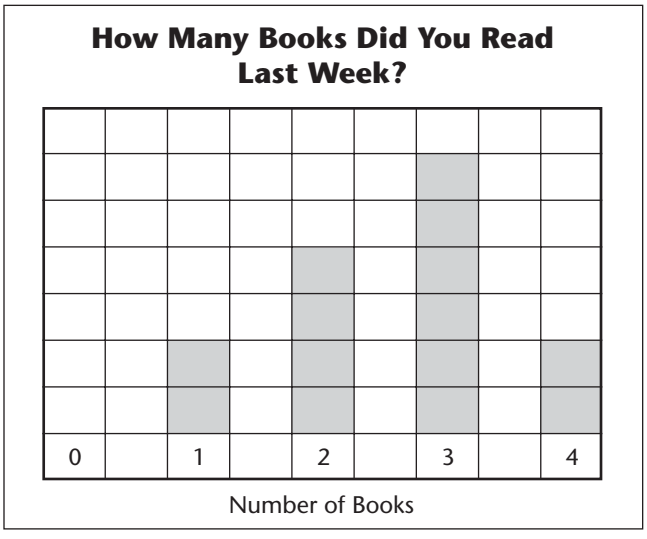
In the early primary grades, opportunities to read graphs usually occur during whole-class discussions in which teachers ask questions that require students to examine and describe data. In Grades 2 and 3, students can work in small groups, with a partner, or independently to read and interpret data, and to write reports to others about their findings. Students should be encouraged to relate the content of their reports to the original question that prompted the collection and organization of data.

Analysing data

In the early primary grades, students are mainly interested in individual pieces of data in graphs (e.g., which picture symbol in a pictograph represents them or their friends, which category has "the most" on a bar graph). By Grade 3, students should be encouraged to look at the data as a whole in order to discover relationships and patterns that are not evident when only pieces of the entire data set are considered.

One way to analyse data is to examine the shape of the data in a graph. Students can examine how the data are distributed across the categories or numeric scale in a graph, and describe the distribution of the data using informal language (e.g., "spread out", "bunched together", "at the high end"). Looking at how data are spread and grouped provides information in a holistic way about the entire group of people or things represented in the graph.

By looking at the shape of the data in a graph, students can see relationships between pieces of data and the entire data set. For example, they can observe not only which category has "the most" but also whether that category has "a lot more" than other categories. Students can also surmise why the display of data looks the way it does (e.g., why the data are spread out, or why they are bunched together).



A set of data can also be analysed by finding how the data are centred. In Grade 3, students learn how to find the mode, that is, the value that occurs most often in the data set. Displaying the data in a graph helps students to identify the mode.

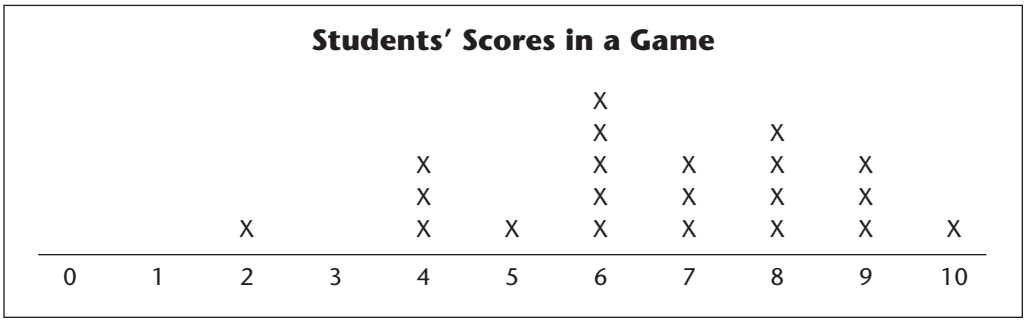
The bar graph shows that most students read 3 books. The mode is 3.

Students should also learn techniques for finding the mode in a set of unorganized data. For example, students might arrange the pieces of data from least to greatest values in a list or in a line plot.

Students' scores in a game:
4 6 7 8 8 4 6 9 2 6 4 6 9 5 6 7 8 10 7 8 9

The scores rearranged from least to greatest:
2 4 4 4 5 6 6 6 6 6 7 7 7 8 8 8 8 9 9 9 10

The score of most students is 6. The mode is 6.



The line plot shows that most students had a score of 6. The mode is 6.

In later grades, students learn to describe sets of data using the mean (found by dividing the sum of the values by the number of values in the data set) and the median (the middle value in a set of values arranged in order).

Characteristics of Student Learning and Instructional Strategies by Grade

KINDERGARTEN

Characteristics of Student Learning

In general, students in Kindergarten:

- compare the size of groups of objects or people (e.g., *bigger, smaller, equal*);
- respond to and pose questions about information presented in people graphs, concrete graphs, and pictographs;
- compare the number of items (objects, persons) in categories of people graphs, concrete graphs, and pictographs; for example, students might say, "Five students chose the apple as their favourite fruit," or "This group is *bigger* than that group."

Instructional Strategies

Students in Kindergarten benefit from the following instructional strategies:

- having them compare the size of groups, following sorting activities (e.g., "There are *more* white buttons than black buttons");
- discussing information presented in people graphs, concrete graphs, and pictographs;
- discussing how each object in a graph corresponds to one student (e.g., discussing how each picture card in a pictograph about favourite pets represents a student's choice of a favourite pet);
- asking them to count and compare the number of items (objects, persons) in different categories of people graphs, concrete graphs, and pictographs; for example, students might say, "Only two students chose yellow as their favourite colour," or "Most students chose red as their favourite colour."

Grade 1

Characteristics of Student Learning

In general, students in Grade 1:

- compare the size of groups of objects or people (e.g., more, fewer, less, same number);
- describe information presented in people graphs, concrete graphs, and pictographs;
- respond to and pose questions about information presented in people graphs, concrete graphs, and pictographs;
- compare the number of items (persons, objects) in categories of people graphs, concrete graphs, and pictographs.

Instructional Strategies

Students in Grade 1 benefit from the following instructional strategies:

- having them compare the size of groups, following sorting activities (e.g., "There are more big lids than small lids");
- discussing how each object in a graph corresponds to one student (e.g., discussing how each picture card in a pictograph about favourite fruits represents a student's choice of a favourite fruit);
- posing questions that require students to examine and describe information in graph;

- asking them to count and compare the number of items in different categories in a graph (e.g., "Five fewer students chose winter than chose summer as their favourite season");
- providing opportunities for students to pose questions about information presented in a graph (e.g., "What question could you ask a classmate about this graph?");
- discussing what a specific graph shows and does not show, for example, by asking them, "What does the graph tell us about our pets? What does the graph not tell us?"

Grade 2

Characteristics of Student Learning

In general, students in Grade 2:

- describe and compare data presented in concrete graphs, pictographs, line plots, bar graphs, and other graphic organizers (e.g., tally charts, Venn diagrams);
- make simple conclusions about information presented in graphs.

Instructional Strategies

Students in Grade 2 benefit from the following instructional strategies:

- posing questions that require students to examine and describe information in graphs and other graphic organizers (e.g., tally charts, Venn diagrams);
- asking them to compare (e.g., *more, less, equal, most, fewest*) the number of items in different categories of a graph;
- discussing the meaning of numbers in graphs, and having students distinguish between numbers that represent data values (e.g., "There are 4 pockets on my clothes"), and numbers that represent frequency (e.g., "There are 5 students who have 4 pockets");
- providing opportunities for students to pose questions about information presented in a graph (e.g., "What question could you ask a friend about this graph?");
- posing questions that encourage students to make simple conclusions about information presented in graphs (e.g., "What does the graph tell us about the favourite game of most students in our class?");
- discussing what a specific graph shows and does not show, for example, by asking them, "What does the graph tell us about our favourite animals? What does the graph not tell us?"

Characteristics of Student Learning

In general, students in Grade 3:

- describe and compare data presented in charts, tables, graphs, and other graphic organizers (e.g., tally charts, Venn diagrams);
- describe the shape of the data (the distribution of the data) in graphs;
- interpret and make conclusions from information presented in charts, tables, and graphs;
- understand how data can be used to prove or disprove a statement.

Instructional Strategies

Students in Grade 3 benefit from the following instructional strategies:

- posing questions that require students to examine and describe information in graphs and other graphic organizers (e.g., tally charts, Venn diagrams);
- asking students to compare (e.g., more, less, equal, most, fewest) the number of items in different categories of a graph;
- providing opportunities for students to pose questions about information presented in a graph (e.g., "What question could you ask a classmate about this graph?");
- posing questions that encourage students to interpret and make conclusions from information presented in charts, tables, and graphs, for example, "Why does the graph show that most students wore a coat today?" "What does the chart tell us about the number of children in most families?";
- discussing what a specific graph shows and does not show, for example, by asking them, "What does the graph tell us about our favourite animals? What does the graph not tell us?";
- discussing the shape of the data (the distribution of the data) in graphs (e.g., "Most of the data are at the high end");
- having students find and discuss the mode (i.e., the value that occurs most often) in a set of data;
- having students judge whether certain statements about information in a graph are correct or incorrect (e.g., "Is this statement true or false? Most students chose milk as their favourite drink.").

Probability

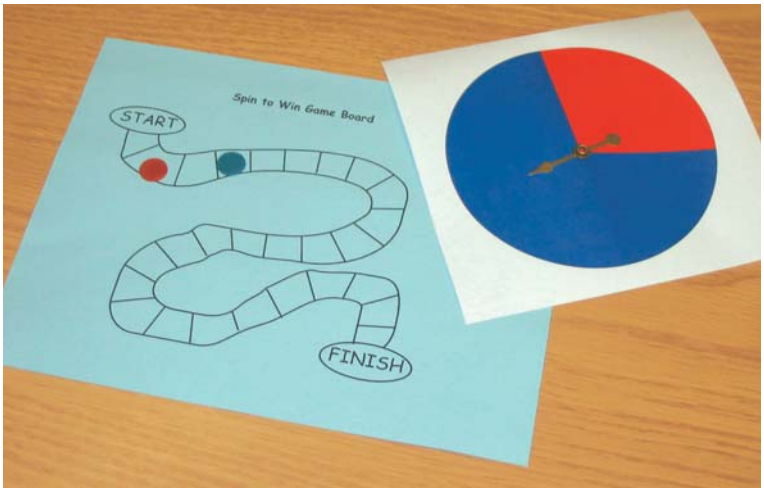
Overview

In the primary grades, students develop informal concepts about probability. Everyday experiences help them understand ideas about the likelihood of events – that some events are likely to happen, while others are unlikely or even impossible. For example, they learn that that the sun will certainly rise tomorrow morning, that snow is unlikely in the summer, and that it is impossible to jump higher than a tall building.

Simple games and experiments help students explore concepts related to probability. Such experiences allow students to make predictions about the outcomes of games or experiments, examine actual outcomes, and discuss reasons for these outcomes. Probability games and experiments also encourage students to confront their misconceptions about chance (e.g., that there are lucky numbers in a game).

The following are key points that can be made about probability in the primary grades:

- The likelihood of an event occurring can be represented along a continuum from impossible to certain.
- Probability can provide a basis for making predictions.



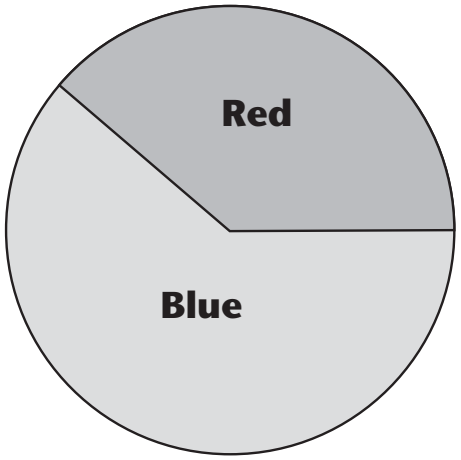
Likelihood as a continuum from impossible to certain

Probability can be represented by a number from 0 to 1 that shows how likely it is that an event will occur: the more likely it is that an event will occur, the greater the number assigned to it. Thus, a probability of 0 represents an impossible event, a probability of 1 represents an event that is certain to occur, and a probability of 1/2 indicates an event that has an equal chance of occurring or not occurring. Representing probability by a number is evident in phrases such as "the chances of that happening are 0", "50% chance of rain", and "a 1 in 4 chance of winning".

In the primary grades, students have not yet developed a strong understanding of numeric values of less than 1. Therefore, the emphasis in instruction is on having students describe the likelihood that an event will occur, using mathematical language (e.g., impossible, unlikely, likely, certain), rather than on teaching students to express probability numerically. Students' daily experiences contribute to their understanding of the likelihood of an event occurring. For example, if the class reads a storybook after recess on a regular basis, students recognize that "story time" is a likely event in their school day.

Students also learn to compare the likelihood of events, thereby developing their understanding of likelihood as a continuum from impossible to certain. By considering past experiences and circumstances surrounding events, students describe events as being more or less likely. For example, students might observe dark clouds and conclude that it is more likely that the weather will be rainy than sunny.

Simple games and experiments involving number cubes (dice) and spinners can also help students compare the likelihood of events. For example, students will realize that if they use the following spinner, it will land on either "red" or "blue", although it is more likely that it will land on "blue".



Comparing the likelihood of different outcomes in games reinforces students' understanding of concepts related to fairness. For example, students might determine that a game involving the spinner illustrated on the previous page is unfair, because there is a greater chance that the spinner will land on "blue". Discussing game materials (e.g., spinners, dice) and game rules allows students to recognize that the fairness of a game is determined by conditions in the game, rather than by the outcome of the game itself (e.g., "I lost, so the game isn't fair").

Probability as a basis for predictions

Probability can be used to predict the likelihood of something happening. In many real-life situations, the collection of data related to specific circumstances provides information that can be used to determine the probability of an event. The use of probability to make predictions is evident in the following statements:

- "There is a 60% chance of rain today."
- "The chances of winning a prize are 1 in 5."
- "The patient has a 50-50 chance of recovery."

In the primary grades, students learn to make predictions about the likelihood of events by experimenting with materials, such as spinners, dice, and coloured cubes drawn from a bag. For example, students might be given a bag containing five red cubes, three green cubes, and two yellow cubes, and be asked to predict the number of times they will draw a red cube, if they draw a cube from the bag ten times (returning each cube to the bag after each draw).

Students' ability to make predictions depends on an informal understanding of concepts related to possible outcomes, randomness, and independence of events. (These terms are for teacher reference only; students are not expected to use or define these terms.)

Possible outcomes: To make a prediction in a situation of chance, it is necessary to know all possible outcomes. For example, when drawing a cube from a bag containing red, blue, and yellow cubes, a possible outcome is a yellow cube, whereas an impossible outcome is a green cube.

Young children do not always recognize the importance of considering all possible outcomes in game situations. For example, they might predict that 15 will be the sum obtained by rolling two regular dice.

Randomness: A random event is not influenced by any factors other than chance. For example, when a regular die is rolled, the result showing any number from 1 to 6 is entirely by chance.

An undeveloped understanding of randomness is evident in young children who believe that luck is an important factor in games. For example, they may believe that the next roll of a die in a game will be a 5, because they "just know it's going to happen", or because 5 is their "lucky number". Young children are often convinced that winning a game of pure chance is due to luck and may not recognize that random chance makes each player equally likely to win.

Independence of events: Independence of events refers to the idea that the outcome of one event does not affect the outcome of another event. For example, if a coin is tossed, lands "tails", and then is tossed again, the chance of the coin showing heads or tails is equal.

Young children often do not have a strong understanding of independence of events and may believe that the outcome of an event is influenced by previous outcomes. For example, after a coin shows tails after three consecutive tosses of the coin, young children may believe that the next flip will be heads because "it is time for heads to show up". They have not yet understood that when they toss a coin, there is an equal chance of heads or tails on each toss of the coin.

Characteristics of Student Learning and Instructional Strategies by Grade

KINDERGARTEN

Characteristics of Student Learning

In general, students in Kindergarten:

- begin to describe the likelihood of everyday events, using simple language (e.g., never, sometimes, always);
- describe events as possible or impossible (e.g., decide whether an event in a story is possible or impossible);
- begin to explore probability in simple games and probability experiments (e.g., determine whether a simple game is fair or unfair).

Instructional Strategies

Students in Kindergarten benefit from the following instructional strategies:

- discussing the likelihood of everyday events, using appropriate language (e.g., never, sometimes, always);
- discussing the likelihood of events in stories (e.g., discussing whether a wolf could actually blow down a house);
- modelling by teachers of language that describes the likelihood of events (e.g., "It has stopped raining, so we will probably be going outside for recess");

- participating in simple probability experiments (e.g., putting cards with students' names in a hat, and predicting whose name will be drawn);
- playing simple games with dice or spinners, and discussing whether the games are fair or unfair.

Grade 1

Characteristics of Student Learning

In general, students in Grade 1:

- describe the likelihood of everyday events, using mathematical language (e.g., impossible, unlikely, less likely, more likely, certain);
- compare the likelihood of events (e.g., "It is more likely that it will snow than rain");
- make predictions based on past experiences (e.g., "I will likely visit my grandpa tomorrow, because my family usually visits him on Saturday");
- explore probability in simple games and probability experiments (e.g., determine whether a simple game is fair or unfair).

Instructional Strategies

Students in Grade 1 benefit from the following instructional strategies:

- discussing the likelihood of everyday events, using mathematical language (e.g., impossible, unlikely, less likely, more likely, certain);
- modelling by teachers of language that describes the likelihood of events (e.g., "It is unlikely that we will all agree on the storybook we like best");
- participating in simple probability experiments (e.g., conducting simple experiments with spinners);
- playing simple games with dice or spinners, and explaining why games are fair or unfair.

Grade 2

Characteristics of Student Learning

In general, students in Grade 2:

- describe the likelihood of events, using mathematical language (e.g., impossible, unlikely, less likely, equally likely, more likely, certain);
- compare the likelihood of events (e.g., "If I roll a number cube, it is equally likely that I will roll a 2 as roll a 5");
- describe probability in simple games and probability experiments (e.g., "The spinner will probably land on blue most often, because the blue area on the spinner is greater than the red area").

Instructional Strategies

Students in Grade 2 benefit from the following instructional strategies:

- discussing the likelihood of events, using mathematical language (e.g., impossible, unlikely, less likely, equally likely, more likely, certain);
- analysing the likelihood that an event will occur (e.g., "It is unlikely that it will snow, because it is warm outside");
- participating in simple probability experiments (e.g., conducting simple experiments with dice);
- playing simple games with dice or spinners, and explaining why games are fair or unfair.

Grade 3

Characteristics of Student Learning

In general, students in Grade 3:

- describe the likelihood of events, using mathematical language (e.g., impossible, unlikely, less likely, equally likely, more likely, certain);
- compare the likelihood of events (e.g., "When I roll a die, it is equally likely that I will roll an even number or an odd number");
- predict the frequency of an outcome in simple games or probability experiments, for example, by saying, "I predict that the spinner will land on blue 5 times and the on red 5 times when I spin the spinner 10 times. I predict this because the spinner is half blue and half red."

Instructional Strategies

Students in Grade 3 benefit from the following instructional strategies:

- discussing the likelihood of events, using mathematical language (e.g., impossible, unlikely, less likely, equally likely, more likely, certain);
- discussing probability as a continuum from impossible to certain, and determining the approximate position of events along this continuum (e.g., "The probability of snow in Canada in August is close to impossible");
- analysing the likelihood that an event will occur (e.g., "It is unlikely that it will snow, because it is warm outside");
- participating in simple probability experiments (e.g., conducting simple experiments with dice);
- playing simple games with dice or spinners, and explaining why games are fair or unfair.

References

Copley, J.V. (2000). *The young child and mathematics*. Washington, DC: National Association for the Education of Young Children.

Curcio, F.R. (2001). *Developing data-graph comprehension in Grades K–8* (2nd ed.). Reston, VA: National Council of Teachers of Mathematics.

Expert Panel on Early Math in Ontario. (2003). *Early math strategy: The report of the Expert Panel on Early Math in Ontario*. Toronto: Ontario Ministry of Education.

Expert Panel on Literacy and Numeracy Instruction for Students With Special Education Needs. (2005). *Education for all: The report of the Expert Panel on Literacy and Numeracy Instruction for Students With Special Education Needs, Kindergarten to Grade 6*. Toronto: Ontario Ministry of Education.

Ma, L. (1999). *Knowing and teaching elementary mathematics*. Mahwah, NJ: Lawrence Erlbaum Associates.

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics*. Reston, VA: Author.

Ontario Ministry of Education. (2004). *The individual education plan (IEP): A resource guide*. Toronto: Author.

Ontario Ministry of Education. (2005). *The Ontario curriculum, Grades 1–8: Mathematics, 2005*. Toronto: Author.

Ontario Ministry of Education. (2006a). *The Kindergarten program*. Toronto: Author.

Ontario Ministry of Education. (2006b). *A guide to effective instruction in mathematics, Kindergarten to Grade 6*. Toronto: Author.

Learning Activities for Data Management and Probability

Contents

Introduction

The following four appendices (Appendices A to D) include learning activities that are practical applications of the big ideas in Data Management and Probability for Kindergarten to Grade 3, respectively. For each grade, one learning activity is included for each of the big ideas: collection and organization of data, data relationships, and probability. These activities do not address all the key concepts for each big idea, since the big ideas cannot be fully addressed in one activity. The learning activities provide a starting point for classroom instruction related to the big ideas; however, students need multiple experiences throughout the school year to build an understanding of each big idea.

The learning activities are organized as follows:

- **CURRICULUM EXPECTATIONS:** The specific expectations are indicated for each learning activity.
- **MATERIALS:** A materials list is included for the main task in each learning activity. (The learning connections have their own materials lists.)
- **ABOUT THE MATH:** Background mathematical information that connects the learning activity to the big idea is provided. In some instances, reference is made to some of the important prior learning that should precede the activity.
- **GETTING STARTED:** This section provides the context for the learning activity, activates prior knowledge, and introduces the problem or task.
- **WORKING ON IT:** In this part, students work on a mathematical task, often in small groups or with a partner. The teacher interacts with students by providing prompts and asking questions.
- **REFLECTING AND CONNECTING:** This section usually includes a whole-class debriefing time that allows students to share strategies and the teacher to emphasize mathematical concepts.
- **ADAPTATIONS/EXTENSIONS:** These are suggestions for ways to meet the needs of all learners in the classroom.
- **MATH LANGUAGE:** Vocabulary that is important to the learning activity and to the concepts presented is included under this heading.

- **ASSESSMENT:** This section provides guidance to teachers on assessing students' understanding of mathematical concepts related to the big ideas.
- **HOME CONNECTION:** This section is addressed to parents or guardians, and includes an activity for students to do at home that is connected to the mathematical focus of the learning activity.
- **LEARNING CONNECTIONS:** These are suggestions for follow-up activities that either consolidate the mathematical focus of the main task or build on other key concepts for the big idea.
- **BLACKLINE MASTERS:** These pages are referred to and used throughout the activities.

The Mathematical Processes

The Ontario Curriculum, Grades 1–8: Mathematics, 2005 identifies seven mathematical processes through which students acquire and apply mathematical knowledge and skills. The mathematical processes that support effective learning in mathematics are as follows:

- problem solving
- reasoning and proving
- reflecting
- selecting tools and computational strategies
- connecting
- representing
- communicating

The learning activities in Appendices A–D demonstrate how the mathematical processes help students develop mathematical understanding. Opportunities to solve problems, to reason mathematically, to reflect on new ideas, and so on, make mathematics meaningful for students. The learning activities also demonstrate that the mathematical processes are interconnected – for example, problem-solving tasks encourage students to represent mathematical ideas, to select appropriate tools and strategies, to communicate and reflect on strategies and solutions, and to make connections between mathematical concepts.

Problem Solving: Each of the learning activities is structured around a problem or inquiry. As students solve problems or conduct investigations, they make connections between new mathematical concepts and ideas that they already understand. The focus on problem solving and inquiry in the learning activities also provides opportunities for students to:

- find enjoyment in mathematics;
- develop confidence in learning and using mathematics;

- work collaboratively and talk about mathematics;
- communicate ideas and strategies;
- reason and use critical thinking skills;
- develop processes for solving problems;
- develop a repertoire of problem-solving strategies;
- connect mathematical knowledge and skills with situations outside the classroom.

Reasoning and Proving: The learning activities described in this document provide opportunities for students to reason mathematically as they explore new concepts, develop ideas, make mathematical conjectures, and justify results. The learning activities include questions that teachers can use to encourage students to explain and justify their mathematical thinking, and to consider and evaluate the ideas proposed by others.

Reflecting: Throughout the learning activities, students are asked to think about, reflect on, and monitor their own thought processes. For example, questions posed by the teacher encourage students to think about the strategies they use to solve problems, and to examine mathematical ideas that they are learning. In the Reflecting and Connecting part of each learning activity, students have an opportunity to discuss, reflect on, and evaluate their problem-solving strategies, solutions, and mathematical insights.

Selecting Tools and Computational Strategies: Mathematical tools, such as manipulatives, pictorial models, and computational strategies, allow students to represent and do mathematics. The learning activities in this guide provide opportunities for students to select tools (concrete, pictorial, and symbolic) that are personally meaningful, thereby allowing individual students to solve problems and to represent and communicate mathematical ideas at their own level of understanding.

Connecting: The learning activities are designed to allow students of all ability levels to connect new mathematical ideas to what they already understand. The learning activity descriptions provide guidance to teachers on ways to help students make connections among concrete, pictorial, and symbolic mathematical representations. Advice on helping students connect procedural knowledge and conceptual understanding is also provided. The problem-solving experience in many of the learning activities allows students to connect mathematics to real-life situations and meaningful contexts.

Representing: The learning activities provide opportunities for students to represent mathematical ideas using concrete materials, pictures, diagrams, numbers, words, and symbols. Representing ideas in a variety of ways helps

students to model and interpret problem situations, understand mathematical concepts, clarify and communicate their thinking, and make connections between related mathematical ideas. Students' own concrete and pictorial representations of mathematical ideas provide teachers with valuable assessment information about student understanding that cannot be assessed effectively using paper-and-pencil tests.

Communicating: Communication of mathematical ideas is an essential process in learning mathematics. Throughout the learning activities, students have opportunities to express mathematical ideas and understandings orally, visually, and in writing. Often, students are asked to work in pairs or in small groups, thereby providing learning situations in which students talk about the mathematics that they are doing, share mathematical ideas, and ask clarifying questions of their classmates. These oral experiences help students to organize their thinking before they are asked to communicate their ideas in written form.

Accommodations and Modifications

The term *accommodations* is used to refer to the special teaching and assessment strategies, human supports, and/or individualized equipment required to enable a student to learn and to demonstrate learning. Accommodations do not alter the provincial curriculum expectations for the grade.

Modifications are changes made in the age-appropriate grade-level expectations for a subject … in order to meet a student's learning needs. These changes may involve developing expectations that reflect knowledge and skills required in the curriculum for a different grade level and/or increasing or decreasing the number and/or complexity of the regular grade-level curriculum expectations.

(Ontario Ministry of Education, 2004, pp. 25 – 26)

The learning activities in Appendices A–D have been designed for students with a range of learning needs. Instructional and assessment tasks are open-ended, allowing most students to participate fully in learning experiences. In some cases, individual students may require *accommodations* and/or *modifications*, in accordance with their Individual Education Plan (IEP), to support their participation in learning activities.

Providing accommodations

Students may require accommodations, including special strategies, support, and/or equipment to allow them to participate in learning activities. There are three types of accommodations:

- *Instructional accommodations* are adjustments in teaching strategies, including styles of presentation, methods of organization, or the use of technology or multimedia.
- *Environmental accommodations* are supports or changes that the student may require in the physical environment of the classroom and/or the school, such as preferential seating or special lighting.
- *Assessment accommodations* are adjustments in assessment activities and methods that enable the student to demonstrate learning, such as allowing additional time to complete tasks or permitting oral responses to test questions.

Some of the ways in which teachers can provide accommodations with respect to mathematics learning activities are listed in the following chart.

Instructional Accommodations

- Vary instructional strategies, using different manipulatives, examples, and visuals (e.g., concrete materials, pictures, diagrams) as necessary to aid understanding.
- Rephrase information and instructions to make them simpler and clearer.
- Use non-verbal signals and gesture cues to convey information.
- Teach mathematical vocabulary explicitly.
- Have students work with a peer.
- Structure activities by breaking them into smaller steps.
- Model concepts using concrete materials, and encourage students to use them when learning concepts or working on problems.
- Have students use calculators and/or addition and multiplication grids for computations.
- Format worksheets so that they are easy to understand (e.g., use large-size font; an uncluttered layout; spatial cues, such as arrows; colour cues).
- Encourage students to use graphic organizers and graph paper to organize ideas and written work.
- Provide augmentative and alternative communications systems.
- Provide assistive technology, such as text-to-speech software.
- Provide time-management aids (e.g., checklists).
- Encourage students to verbalize as they work on mathematics problems.
- Provide access to computers.
- Reduce the number of tasks to be completed.
- Provide extra time to complete tasks.

Environmental Accommodations

- Provide an alternative workspace.
- Seat students strategically (e.g., near the front of the room; close to the teacher in group settings; with a classmate who can help them).
- Reduce visual distractions.
- Minimize background noise.
- Provide a quiet setting.
- Provide headphones to reduce audio distractions.
- Provide special lighting.
- Provide assistive devices or adaptive equipment.

Assessment Accommodations

- Have students demonstrate understanding using concrete materials or orally rather than in written form.
- Have students record oral responses on audiotape.
- Have students' responses on written tasks recorded by a scribe.
- Provide assistive technology, such as speech-to-text software.
- Provide an alternative setting.
- Provide assistive devices or adaptive equipment.
- Provide augmentative and alternative communications systems.
- Format tests so that they are easy to understand (e.g., use large-size font; an uncluttered layout; spatial cues, such as arrows; colour cues).
- Provide access to computers.
- Provide access to calculators and/or addition and multiplication grids.
- Provide visual cues (e.g., posters).
- Provide extra time to complete problems or tasks or answer questions.
- Reduce the number of tasks used to assess a concept or skill.

Modifying curriculum expectations

Students who have an IEP may require modified expectations, which differ from the regular grade-level curriculum expectations. When developing modified expectations, teachers make important decisions regarding the concepts and skills that students need to learn.

Most of the learning activities in this document can be adapted for students who require modified expectations. The following chart provides examples of how a teacher could deliver learning activities that incorporate individual students' modified expectations.

Modified Program	What It Means	Example
Modified learning expectations, *same* activity, *same* materials	The student with modified expectations works on the same or a similar activity, using the same materials.	The learning activity involves displaying data in a bar graph using many-to-one correspondence (e.g., one sticker to represent two students). Students with modified expectations display data using one-to-one correspondence.
Modified learning expectations, *same* activity, *different* materials	The student with modified expectations engages in the same activity but uses different materials that enable him or her to remain an equal participant in the activity.	The activity involves students creating their own graphs with appropriate titles and labels. Students with modified expectations complete graphs on prepared templates.
Modified learning expectations, *different* activity, *different* materials	The student with modified expectations participates in different activities.	Students with modified expectations work on probability activities that reflect their learning expectations, using a variety of concrete materials.

(Adapted from *Education for All: The Report of the Expert Panel on Literacy and Numeracy Instruction for Students With Special Education Needs, Kindergarten to Grade 6, 2005*, p. 119)

It is important to note that some students may require both accommodations and modified expectations.

A Special Note About Kindergarten

The Kindergarten years represent a two-year continuum for those students who attend both Junior Kindergarten and Senior Kindergarten. In many classrooms, Junior Kindergarten and Senior Kindergarten students work together in multi-age groups. Therefore, it is important to assess and consider students' level of development of early mathematical understandings before planning any math activities. Many of the Data Management and Probability learning activities are multilevel and can be used with both age groups. In some cases, suggestions are made for adapting an activity for students in Junior Kindergarten.

Often, teachers in a multi-age classroom have the Senior Kindergarten students complete a small-group or independent follow-up activity after modelling or demonstration is done for the whole class. When invited, many Junior Kindergarten students will join in the activity, even though they are not required to participate. This willingness to learn can give teachers a greater understanding of students' level of mathematical knowledge and skills. Although teachers will have different expectations for younger students, sometimes the level of understanding that Junior Kindergarten students demonstrate surprises teachers. Providing instruction that meets the unique needs of each student helps to support further learning.

A. Kindergarten Learning Activities

Appendix Contents

Button, Button, Who's Lost a Button?

BIG IDEA **Collection and Organization of Data**

CURRICULUM EXPECTATIONS

Students will:

- sort, classify, and compare objects and describe the attributes used *(e.g., initially: sort them into piles or collections on the basis of a common attribute; eventually: state the rule they used to sort, classify, and compare)*;
- respond to and pose questions about data collection and graphs.

MATERIALS

- *Frog and Toad Are Friends* by Arnold Lobel (if available)
- chart paper
- COK.BLM1: Shirt Template (1 per student)
- tape or stick tack
- COK.BLM2a–b: Buttons
- small containers of 10 to 15 buttons (1 container per student)
- *The Button Box* by Margarette S. Reid (if available)
- a box containing a large number of buttons
- COK.BLM3: Sorting Mat
- COK.BLM4: Venn Diagram
- COK.BLM5: Sorting at Home (1 per student)

Note: Buttons can be purchased in bulk at craft stores and discount stores. You might also send home a note to parents asking them to donate unneeded buttons to the class.

ABOUT THE MATH

Sorting activities provide opportunities for students to describe objects, identify their attributes, see relationships between them, and organize them into categories. Young students initially sort objects according to obvious attributes (e.g., colour) and may not recognize other, less obvious attributes. They sort objects into "are" and "are not" groups, for example, "All of these objects are green. All of these objects are not green." With experience, students learn that the same set of objects can be sorted in different ways, and begin to sort and classify objects using less obvious attributes (e.g., size, texture, mass).

It is important to recognize that Kindergarten students are at different stages in their ability to sort. Students require many experiences in sorting and classifying a variety of materials, and in exploring different ways to sort them.

GETTING STARTED

If possible, obtain a copy of *Frog and Toad Are Friends* by Arnold Lobel (New York: HarperCollins, 1979). Read the chapter entitled "The Lost Button" to the class. Discuss the characteristics of the lost button. On chart paper, make a list, with visual cues, of the attributes that describe Toad's button. Ask: "How did Frog and Toad know that they had the correct button?" If students have difficulty describing the correct button, refer them to the list of attributes.

Display a copy of COK.BLM1: Shirt Template, and explain that the picture represents Toad's shirt. Use tape or stick tack to affix three buttons (made from COK.BLM2a–b: Buttons) to the shirt that are alike in some way (e.g., same colour, same number of holes, same size, same shape). Explain that Toad lost another button. Tell students that, this time, the buttons on his shirt are not exactly the same, but are alike in some way. Show students three or four other buttons. (One of these buttons must share the common characteristic of the buttons already affixed to the shirt.) Ask students to examine these buttons and to identify the one that is missing from Toad's shirt. After students agree on the missing button, affix it to the shirt. Ask students to explain why they think that the new button is the missing button. Discuss how all four buttons on the shirt share a common attribute. Repeat the activity using other sets of buttons.

Provide each student with a copy of COK.BLM1: Shirt Template and a small container of 10 to 15 buttons. Instruct students to sort their buttons (e.g., according to colour, number of holes, size). After students find a set of buttons that are alike in some way, they may place the buttons on their shirt template.

Note: At the beginning of the activity, students may spend a lot of time examining the buttons and picking out their favourite ones. Allow time for this exploration in order to help students become familiar with their buttons and possible ways to sort them.

Observe students as they sort the buttons and as they select a set of buttons for their shirt templates. Ask questions, such as the following:

- "How are you sorting your buttons?"
- "Why did you put this button in this group?"
- "In which group should you put this button?"
- "How are these buttons alike?"
- "Why did you choose these buttons to put on the shirt?"

Later, materials for this activity can be provided at a learning centre where students can continue to sort buttons in different ways. Provide copies of COK.BLM1: Shirt Template on which students can place or glue buttons that share a common attribute. Provide opportunities for students to describe the different attributes of buttons on the shirts.

WORKING ON IT

Have students sit in a circle. Read *The Button Box* by Margarette S. Reid (New York: Dutton Children's Books, 1990), if available, to students. Discuss the different types of buttons that are in the button box. Next, show a box containing a large number of buttons and spill the contents onto the floor in the middle of the circle. Invite students to take a small handful of buttons back to their spot in the circle. Encourage them to examine their buttons and to sort them in different ways.

Students may demonstrate a range of sorting skills:

- Some students might create subsets of buttons based on observable features, without applying a consistent sorting rule. For example, students might create a group of red buttons, and then observe that some of the remaining buttons are shiny and create a subset of shiny buttons.
- Some students might sort the collection of buttons by a single attribute, observing whether each object in the collection has or does not have an attribute. For example, students might create two subsets of buttons: those that are red, and those that are not red.
- Some students might sort the buttons according to a general characteristic. For example, students might observe that the buttons are different colours, and create subsets according to colour (e.g., red buttons, green buttons, black buttons, white buttons).
- Some students might sort the buttons according to two or more attributes. For example, students might create subsets of buttons that are red with two holes, red with four holes, green with two holes, green with four holes, and so on. (This level of sorting is generally not achieved by Kindergarten students.)

Reconvene students after they have had an opportunity to sort the buttons in different ways. Record "Some buttons are …" on a sheet of chart paper. Ask students to describe buttons in their collections, and record their ideas on chart paper. Provide visual clues to help students understand attributes that have been recorded.

After completing the list, ask students to find characteristics that go together. For example, you might comment that some of the words describe colours, and invite

students to find colour words in the list. Students might also find other categories, such as the following:

- size: small, medium, large
- number of holes: two holes, three holes, four holes
- texture: rough, smooth
- shape: round, square

Provide an opportunity for students to sort a small collection of buttons again. Encourage them to think about the different attributes that were listed on the chart paper, and to find new ways to sort their buttons. It may be necessary to help some students use sorting criteria that go beyond obvious attributes (e.g., colour). Have these students describe the buttons in their collections, and encourage them to think about different ways to sort the buttons.

Place the button box at a learning centre, and encourage students to sort the buttons in different ways when they visit the centre in the next few days. As students find different ways to sort the buttons at the centre, add any new attributes of buttons to the list.

REFLECTING AND CONNECTING

Play What Is My Rule? To play this game, choose an attribute from the "Some buttons are …" list developed with students, but don't tell students which characteristic you have selected. As students watch, sort a handful of buttons according to the chosen attribute. Ask students to state which attribute you used to sort the buttons.

Invite individual students to choose an attribute from the list, sort a handful of buttons accordingly, and ask classmates to find how they sorted the buttons.

ADAPTATIONS/EXTENSIONS

Some students may have difficulties sorting buttons. Pose questions that help these students to focus on the shared attributes of two or more buttons, for example, "How are these two buttons alike?" "How are these buttons different?" "What other buttons are the same colour as these two buttons?"

Scaffold the activity for students who experience difficulties. The following questions can guide students in sorting buttons:

- "Which two buttons are the same in some way? How are they the same?"
- "Which other button is also like these two buttons? Why is this button like the others?"
- "Which other buttons could we add to the group?"
- "Why do all these buttons belong to the same group?"

The activity can be extended by providing different sorting mats for students to use. Students might use COK.BLM3: Sorting Mat to help them sort objects into "are" and "are not" groups (e.g., "All the buttons in this group are striped, and all the buttons in this group are not striped"). Students could also use COK.BLM4: Venn Diagram to sort buttons according to two attributes (e.g., red buttons, buttons with two holes), and to consider which buttons possess both attributes (and belong in the section of the Venn diagram where the circles overlap).

MATH LANGUAGE

- same
- different
- descriptions of attributes (e.g., big, red, round, rough, shiny)

ASSESSMENT

Observe students to assess how well they:

- compare buttons according to observable attributes;
- describe the attributes of buttons;
- apply a consistent rule as they sort a collection of buttons;
- sort buttons in more than one way, according to different attributes.

As you observe individual students, assess the complexity of their sorting methods. Do they:

- create subsets of buttons without applying a consistent sorting rule?
- sort the buttons into "are" and "are not" groups?
- sort the buttons according to a general characteristic (e.g., colour, size, texture)?
- sort the buttons according to two or more attributes?

HOME CONNECTION

Send home COK.BLM5: Sorting at Home. This Home Connection activity provides ideas on ways parents can involve students in sorting activities at home. Provide an opportunity in class for students to share their pictures of how they sorted objects at home.

LEARNING CONNECTION 1

Which Button Doesn't Belong?

Materials

- COK.BLM1: Shirt Template
- buttons made from COK.BLM2a–b: Buttons
- tape or stick tack

Display a copy of COK.BLM1: Shirt Template. Affix four buttons (made from COK.BLM2a–b: Buttons) to the template, including three buttons that share a common attribute and a fourth button that doesn't match. Have students determine which button does not belong.

LEARNING CONNECTION 2

Who Has Your Button?

Materials

- set of buttons made from COK.BLM2a–b: Buttons
- safety pins or tape
- 1 oversized shirt

Have students sit in a circle. In the middle of the circle, display a set of buttons made from COK.BLM2a–b: Buttons. Invite a student to select three or four buttons that share a common attribute. After discussing the common attribute with students, pin or tape the buttons onto an oversized shirt, and have a student wear the shirt. Next, remove one of the buttons from the shirt and select four other buttons from the collection in the middle of the circle. Have the student wearing the shirt close his or her eyes as you give the five buttons to students in the circle. Have students in the circle hide their hands behind their back so that it appears that all are hiding a button.

Have students chant: "Button, button, who has your button? Could it be you? Could it be you?" Have the student wearing the shirt try to guess who is hiding the missing button. He or she may guess three times, and then the student with the missing button must reveal it. Discuss why the button is the missing button. Play the game several times, with a different student wearing the shirt each time.

LEARNING CONNECTION 3

Sorting in Many Different Ways

Material

- a variety of materials for sorting (e.g., attribute blocks, small plastic animals, lids, buttons, marbles, shells, painted stones)

Provide many opportunities for students to sort the same materials in different ways. Observe how students sort the materials.

- Do students choose to sort the materials according to obvious attributes (e.g., colour)?
- Are students able to sort according to less obvious attributes (e.g., size, texture, shape)?

- Do students sort materials into "are" and "are not" groups (e.g., "The objects in this group are red, and the objects in this group are not red"), or do they sort objects according to general attributes (e.g., sorting materials into colour groups)?
- Are students able to explain how they sorted the materials?

It may be necessary to encourage students to sort materials according to less obvious attributes. Have students describe the materials in order to identify characteristics that students may not have observed previously. Then ask them to think about how they described the materials, and to use these ideas to help them find a new way to sort the materials.

LEARNING CONNECTION 4

What Is My Sorting Rule?

Materials

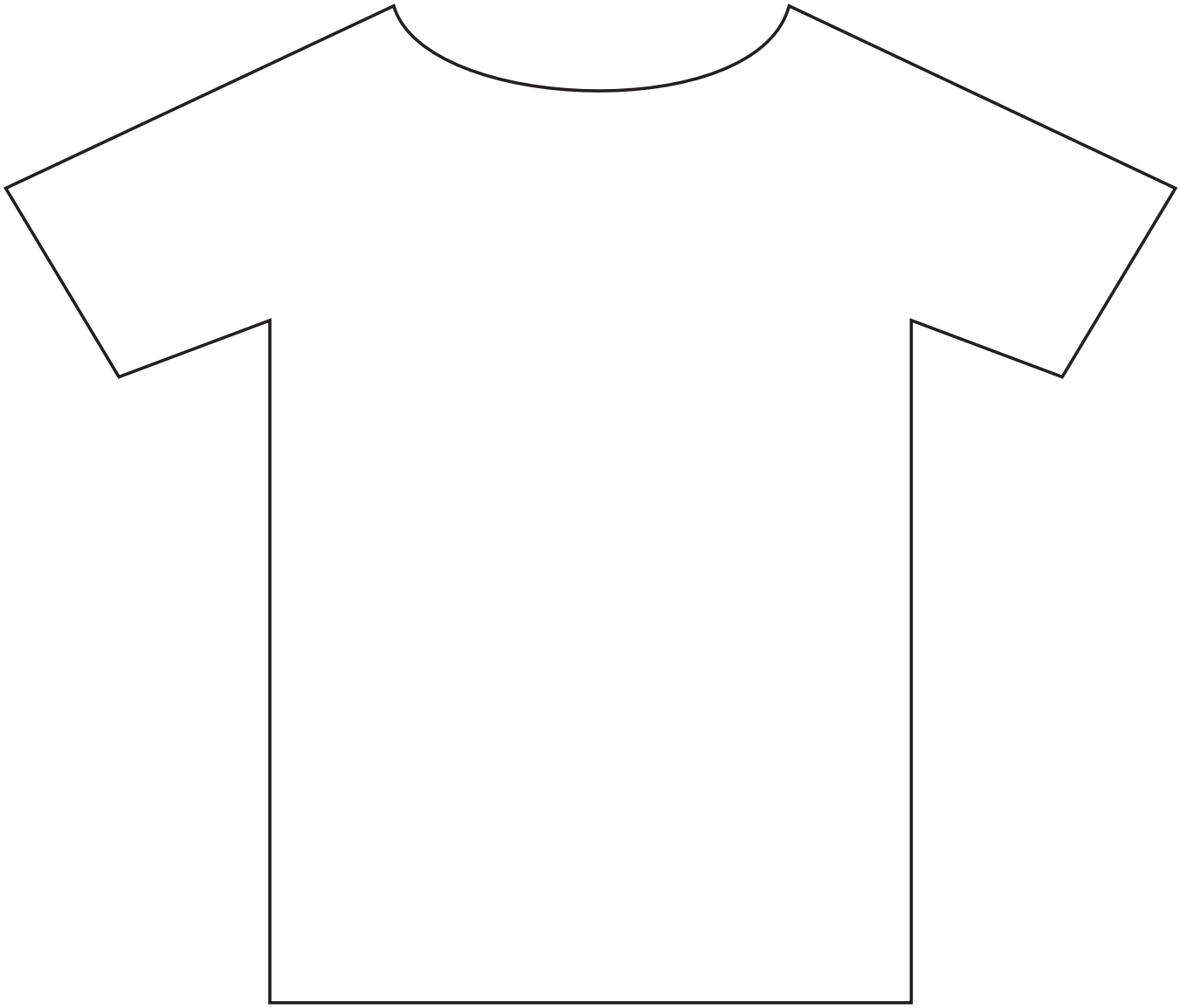
- paper or cloth bags containing 10 to 15 items for sorting (e.g., attribute blocks, pattern blocks, small plastic animals, lids, buttons, marbles, shells) (1 bag per pair of students)

Organize students into pairs. Display the bags and explain that they contain items that can be sorted in different ways. Invite each pair to select a bag. Explain the activity:

- One student in each pair sorts the contents of the bag according to a "secret" sorting rule.
- The other student looks at the sorted objects and tries to determine the rule.
- After the student has determined how the materials were sorted, he or she takes a turn at sorting the materials.
- His or her partner tries to determine how the objects were sorted.
- After both students have taken a turn sorting the materials, they return the bag and select another one.
- Pairs sort the materials in the new bag, and have their partners determine how they sorted the objects.

Shirt Template

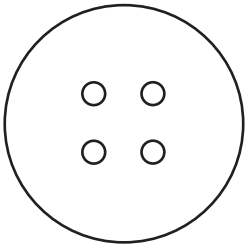
COK.BLM1

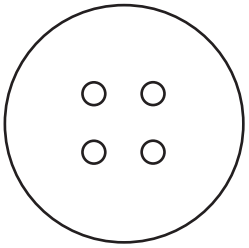


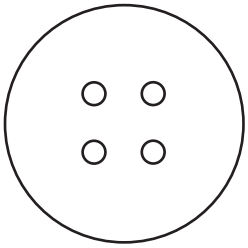
COK.BLM2a

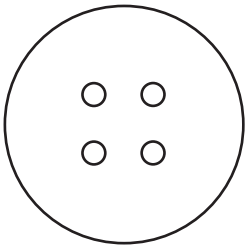
Buttons

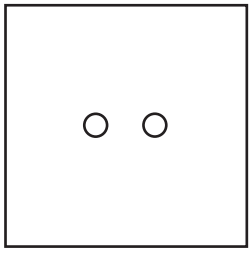
Colour the buttons red, yellow, green, or blue before cutting them out.

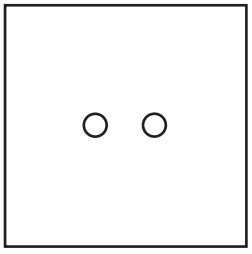


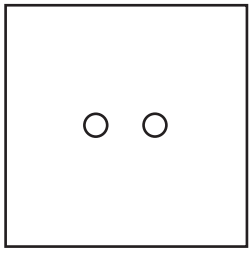


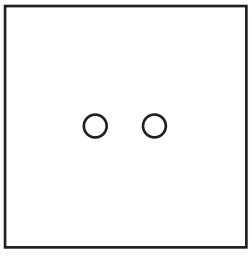




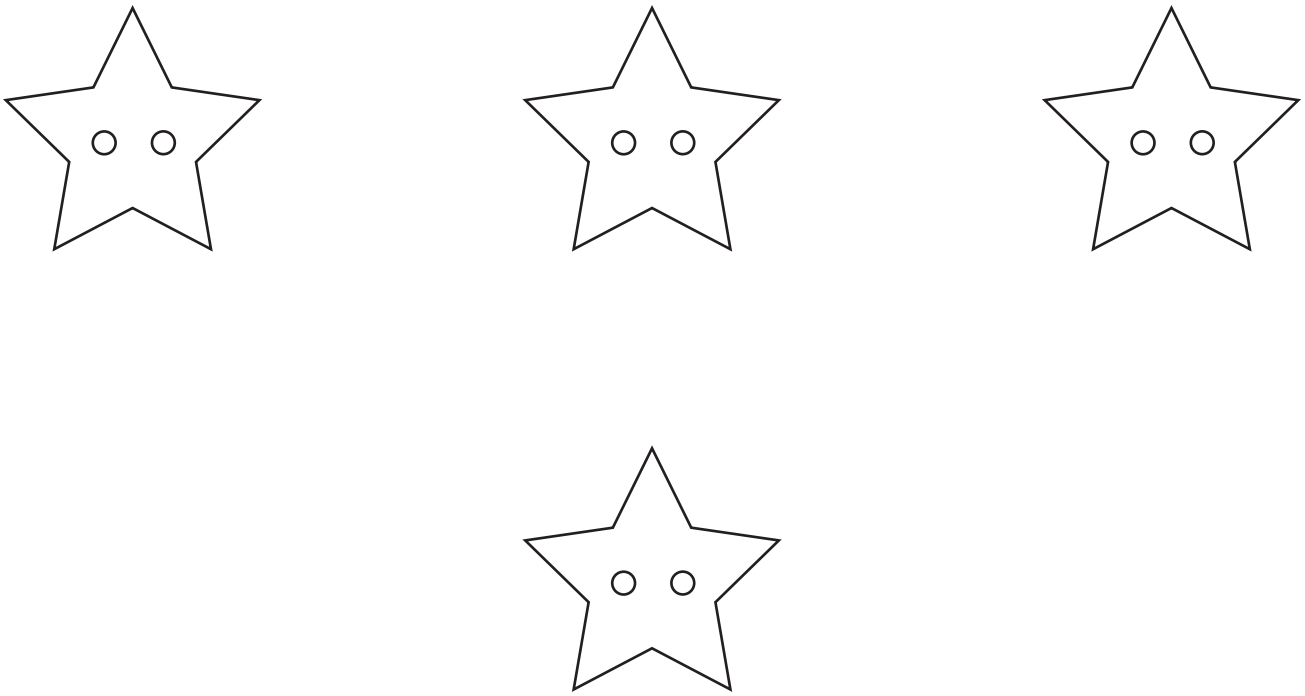




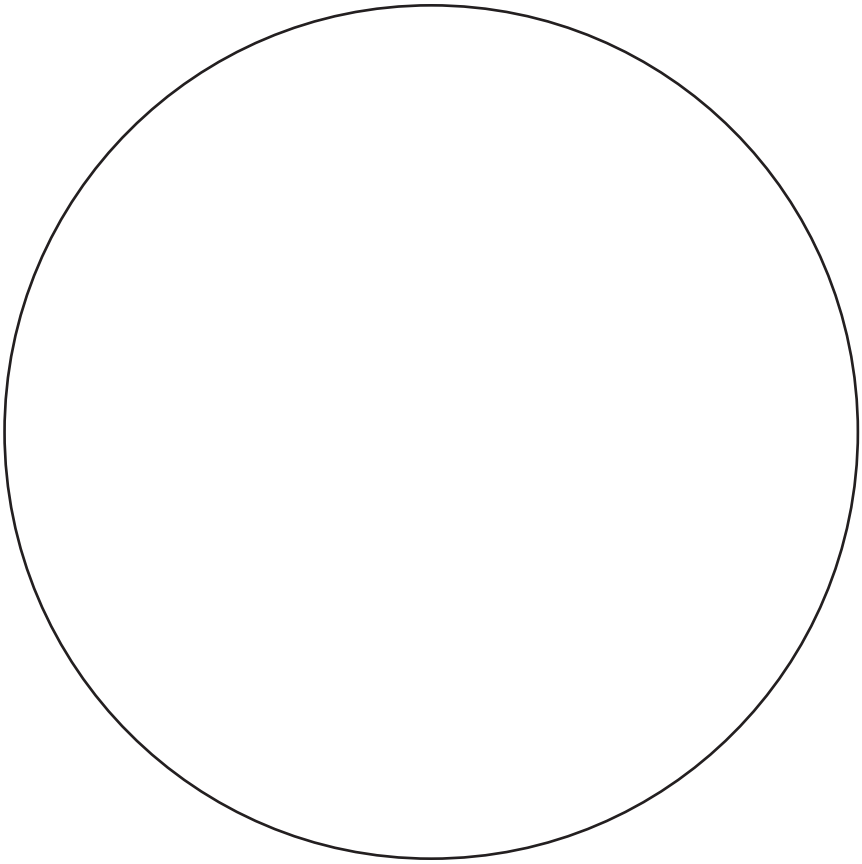


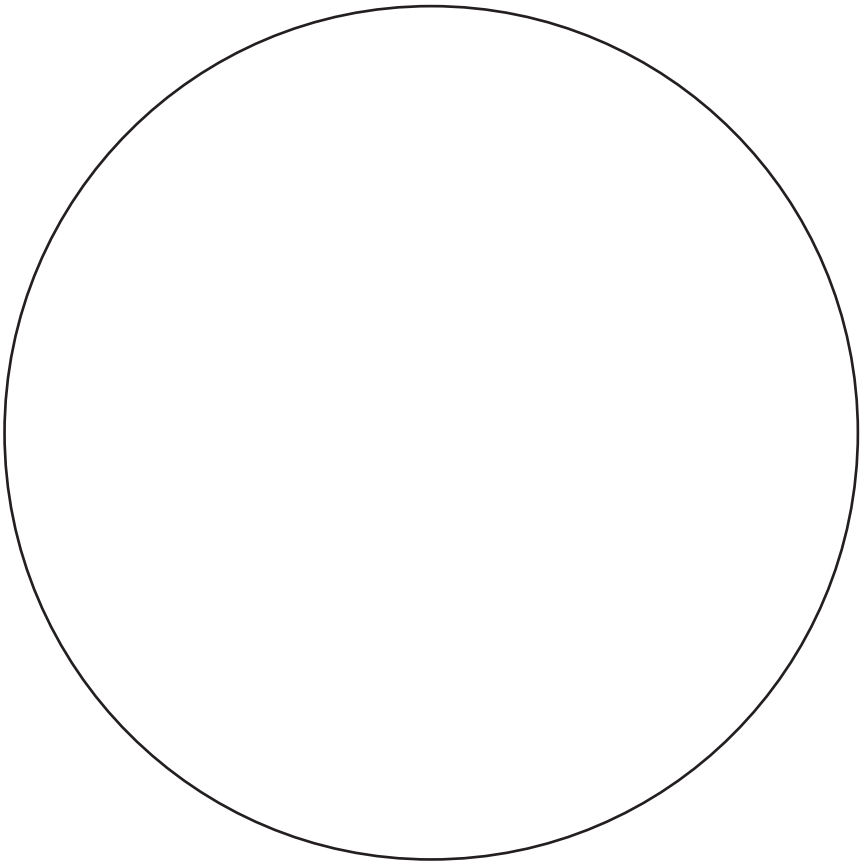


Buttons

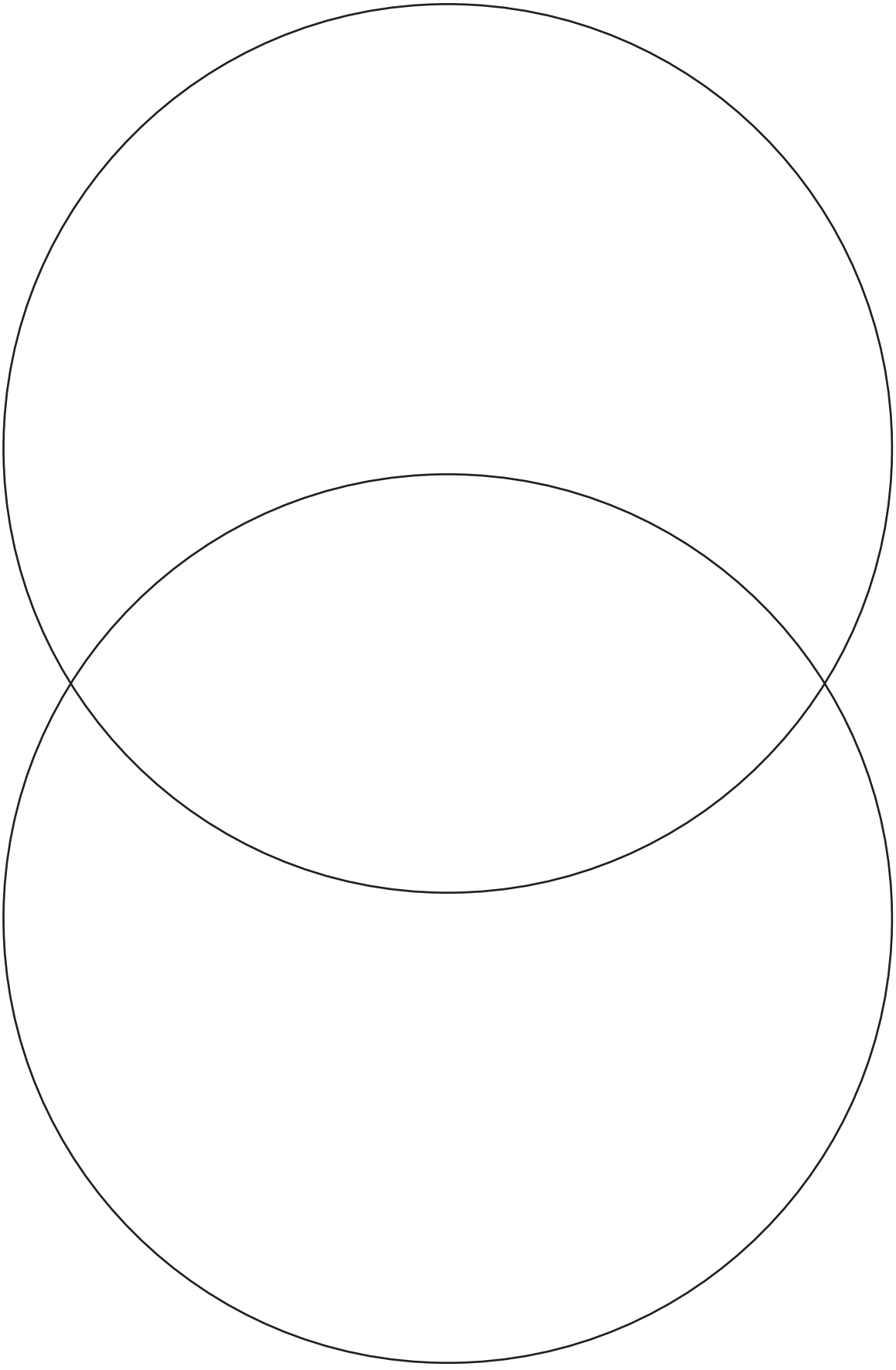


Sorting Mat





Venn Diagram



COK.BLM4

Sorting at Home

Dear Parent/Guardian:

Our class has been examining buttons and discussing their characteristics, such as colour, size, texture, and number of holes. Students have also been sorting collections of buttons in different ways.

Learning to sort objects is an important skill. You can help your child develop sorting skills at home by having him or her help you sort laundry, groceries, dishes, or toys.

After you and your child have sorted laundry, groceries, dishes, or any other objects in your home, talk about how the objects were sorted. Also discuss the importance of sorting objects. For example, it is easier to find dishes in cupboards when they are sorted.

Have your child draw a picture of what he or she sorted. (Your child can draw the picture on the back of this page.) Send the picture to school so that your child can share it with the class.

You can also help our class by donating any buttons that you no longer need. Your donation will allow the class to continue exploring different ways to sort buttons!

Thank you.

What Kinds of Shoes Are We Wearing?

BIG IDEA **Data Relationships**

CURRICULUM EXPECTATIONS

Students will:

- collect objects or data and make representations of their observations, using concrete graphs *(e.g., conduct simple surveys and use graphs to represent the data collected from questions posed; use a variety of graphs, such as graphs using people to represent things, bar graphs, pictographs; use tally charts)*;
- respond to and pose questions about data collection and graphs.

MATERIALS

- shoes worn by students
- 3 sets of cards made from DRK.BLM1a–b: What Kinds of Shoes Are We Wearing?
- chart paper
- interlocking cubes
- DRK.BLM2: What Kinds of Shoes Are in Our Home? (1 per student)

ABOUT THE MATH

Creating people graphs in which students themselves represent the data allows Kindergarten students to experience physically how information can be categorized. When students create people graphs, they are able to easily recognize the quantities of students in different groups and can readily compare quantities (e.g., "This group is larger than that group").

Kindergarten students also learn that data can be represented in concrete graphs (e.g., bar graphs made with interlocking cubes). By observing, counting, and comparing the quantities in different parts of the graph, students can describe information presented in the graph.

In this activity, students create a people graph in which they themselves represent data, and then create a concrete graph using the same data. This experience helps students to understand that the same data can be represented in different ways.

GETTING STARTED

Begin a discussion about shoes by telling the following story to the class:

"Last weekend, I went shopping for a new pair of shoes. At the store, the salesperson showed me many different shoes. Some had laces just like [Jolene's] shoes, others had sticky straps just like [Sunja's] shoes, and others had buckles just like [May's]. There were also some shoes that didn't have fasteners – you just slip them on your feet.

"After looking at so many different shoes, I began to wonder: What kinds of shoes do the students in this class have? How many students have shoes with laces? with sticky straps? with buckles? How many students have shoes that they just slip on? I had so many questions.

"I wonder if you can help me find the answers to questions about shoes in our class. How can I find out how many students in our class are wearing each kind of shoe?"

Have students explain how they might find the number of students wearing each kind of shoe. For example, they might suggest that students create groups according to the kinds of shoes they are wearing, and then count the number of students in each group. Try the strategies students suggest and discuss whether they are good ways to find the number of students wearing each kind of shoe.

WORKING ON IT

Explain that creating a people graph is a way to find the number of students who are wearing each kind of shoe.

Show cards labelled "Laces", "Sticky Straps", "Buckles", and "Slip On" (made from DRK.BLM1a–b: What Kinds of Shoes Are We Wearing?) and discuss the kind of shoe that is represented by each card. Place the cards in a row, and ask students to stand in a line behind the card that represents the kind of shoe they are wearing. After students are standing in the appropriate line, have them sit down in their line.

Ask: "How could we find the number of students who are wearing shoes with laces? with sticky straps? with buckles? that just slip on?" Together, count the number of students in each line, and record the results on chart paper.

What Kinds of Shoes Are We Wearing?

Laces: 10

Sticky Straps: 6

Buckles: 1

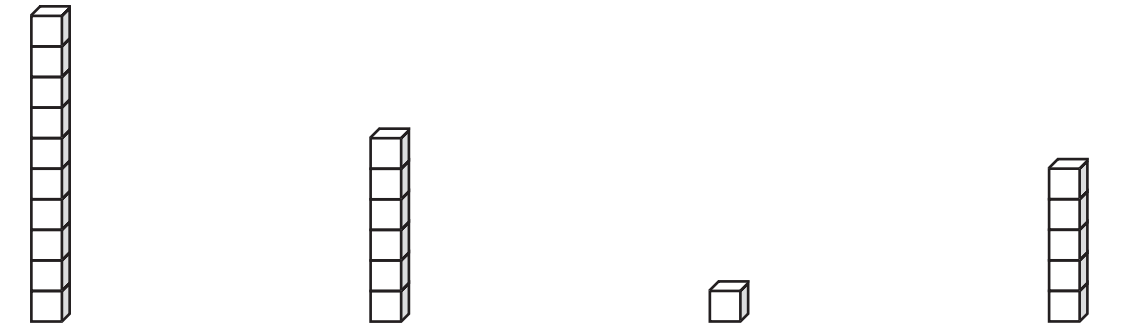
Slip On: 5

Ask:

- "Which kind of shoe are most students wearing? How do you know?"
- "Which kind of shoe are fewest students wearing? How do you know?"
- "Are there more shoes with laces or with buckles? How do you know?"

Extend the activity in order to help students understand that the data about different kinds of shoes can be represented in different ways. Show the class four bowls labelled with a second set of cards made from DRK.BLM1a–b: What Kinds of Shoes Are We Wearing? Give students each an interlocking cube, and ask them to place their cube in the bowl that corresponds to the kind of shoe they are wearing. Ask: "How many cubes are in the bowl labelled 'Laces'? How do you know?" Recognize that some students may be uncertain about the number of cubes in the bowl; they might not fully understand the one-to-one correspondence between each student and each cube. It is important to have students count the cubes and to connect the count with the data recorded earlier on chart paper. Discuss and count the number of cubes in the other bowls, and relate these numbers to the data recorded on chart paper.

Next, snap together the cubes in each bowl, and create a concrete bar graph. Use a third set of cards made from DRK.BLM1a–b: What Kinds of Shoes Are We Wearing? to label the bars.



Help students understand that the concrete bar graph contains the same data that students represented in the people graph they created earlier. Ask:

- "According to our concrete bar graph, how many students are wearing shoes with laces? with sticky straps? with buckles? that slip on?"
- "How do we know that the number of cubes in the 'Laces' bar is 10?"
- "How can we know the number of students in each group without counting the cubes?"

Continue to discuss the data presented in the concrete bar graph by asking questions, such as the following:

- "What kind of shoes are most students wearing? How do you know?"
- "What kind of shoes are fewest students wearing? How do you know?"
- "Are more students wearing shoes with laces or shoes with sticky straps? How do you know? Do you need to count the number of cubes in each bar to find which bar has more cubes?"

REFLECTING AND CONNECTING

Pose questions that encourage students to reflect on the activity:

- "What did we learn about the shoes that we wear?"
- "How were our people graph and our concrete bar graph the same? How were they different?"
- "Was it easier to get information about shoes in our people graph or concrete bar graph? Why?"
- "If we made a concrete bar graph about our shoes tomorrow, would the graph look the same as the graph we made today? Why?"
- "If we made a concrete bar graph about the shoes worn by Grade 1 students, would the graph look the same as the graph we made today? Why?"

ADAPTATIONS/EXTENSIONS

Some students may have difficulty understanding that the same data can be represented in a people graph and a concrete bar graph. Help students to see the relationships between both representations of data: have them count the number of students in each line of the people graph, and the number of cubes in each bar of the bar graph, and ask them to explain why both counts result in the same number. Throughout the activity, refer to the data recorded on chart paper to emphasize that the number in each group does not change despite the different ways it is represented.

Extend the activity by having students work independently or with a partner to collect and organize data about shoe colour (or any other clothing worn by students). Providing opportunities for students to gather data on their own helps them to understand the processes involved in data collection and organization.

MATH LANGUAGE

- people graph
- concrete bar graph
- many, more, most
- few, fewer, fewest

ASSESSMENT

Observe students to assess how well they:

- decide in which category they belong (i.e., according to the kind of shoe they are wearing);
- find the number of students in each category (e.g., by counting);
- explain that the same data can be represented in a people graph and a concrete bar graph;
- compare quantities based on the data presented in people and concrete graphs.

HOME CONNECTION

Send home DRK.BLM2: What Kinds of Shoes Are in Our Home? This home connection activity provides an opportunity for parents and students to make a simple bar graph. Provide an opportunity for students to share their bar graphs with classmates.

LEARNING CONNECTION 1

Shoe Pictographs

Materials

- cards cut from DRK.BLM3: Shoe Templates (1 card per student)
- crayons
- tape or stick tack
- chart paper

Provide each student with one card cut from DRK.BLM3: Shoe Templates. (Students receive the outline of either a small, medium-sized, or large shoe.) Instruct students to draw laces, sticky straps, or a buckle on their shoe, and to colour their shoe using one colour of crayon.

Together, create pictographs using students' completed cards. Discuss what the pictograph might show (i.e., shoes categorized according to size, colour, or type of fastener), and have students categorize their card by arranging them into appropriate columns on the board or chart paper. Students can use tape or stick tack to post their cards.

Pose questions, such as the following, to help students read information from the graph.

- "Which column has the most shoes?"
- "Which column has the fewest shoes?"
- "How many shoes are red?"
- "Are there fewer blue shoes than red shoes? How do you know?"
- "Do more shoes have laces or buckles?"

LEARNING CONNECTION 2

Getting Ready to Play

Materials

- 4 or 5 outdoor play items (e.g., skipping rope, scooter, sponge ball, hoop, volleyball)

At the beginning of an outdoor play session, show students four or five different play items (e.g., skipping rope, scooter, sponge ball, hoop, volleyball). Tell students that they will make a people graph to find how many students choose each kind of play item. Arrange the play items in a row. Ask students to choose one of the items and stand in line behind their chosen item.

After all students are standing in a line, ask the following questions:

- "Which play item did most students choose? How do you know?"
- "Which play item did the fewest students choose? How do you know?
- "Did more students choose the sponge ball or the skipping rope?"
- "We have only five skipping ropes. Are there enough ropes for every student in this line?"

Discuss how there might not be enough play items for each student in a line. Ask students how they might solve this problem. For example, students might suggest that students play with a partner and share the play item, or that students volunteer to move to a line in which there are fewer students.

LEARNING CONNECTION 3

Which Book Shall We Read?

Materials

- storybooks (2 or 3 per day)
- clothespins (1 per student)
- strips of paper or pieces of ribbon (1 for each storybook)

Have students vote for the book they would like to hear in a read-aloud session. Set up two or three books on a table or ledge and give a brief description of each story. Place a strip of paper or a piece of ribbon beside each book. Provide each student with a clothespin. Invite students to vote for the story they would like to hear by clipping their clothespin onto the appropriate strip of paper or ribbon.

Ask questions that help students think about the results of the vote:

- "Which book received the most votes? How do you know?"
- "Which book received the fewest votes? How do you know?"
- "Why do you think this story received the most votes?"
- "How can we check to make sure that this story received the most votes?"

Students may suggest that counting the number of clothespins is a way to check which book received the most votes. Encourage students to think of other ways (*e.g.*, placing the clothespins for each book end to end and comparing the length of the rows). Repeat this activity each time a read-aloud session is planned.

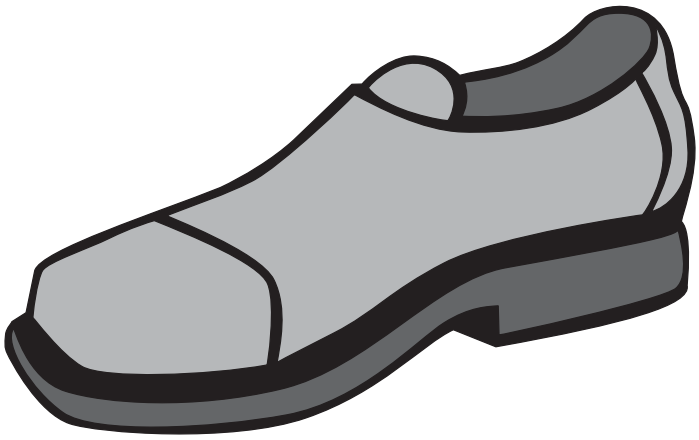
What Kinds of Shoes Are We Wearing?

Laces

Sticky Straps

What Kinds of Shoes Are We Wearing?

Buckles



Slip On

DRK.BLM2

What Kinds of Shoes Are in Our Home?

Dear Parent/Guardian:

Our class has been learning about making graphs to show information. Ask your child to tell you about the graph we made about shoes. Ask him or her to explain what we learned about the shoes in our class.

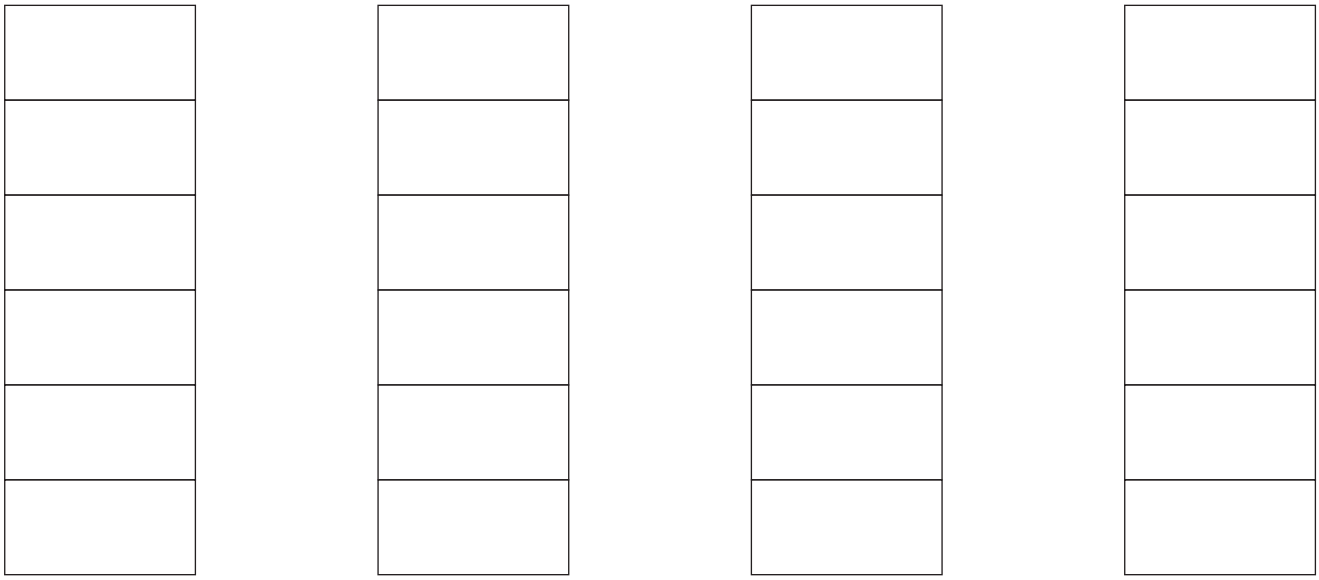
Help your child make a simple graph about the shoes in your home. Have your child decide whether each pair of shoes has laces, sticky straps, or buckles, or whether they are slip-on shoes. Next, have your child colour in a space in the appropriate column in the graph below for each pair of shoes.

Ask your child questions about the graph:

- "What type of shoes are there the most of in our home? How do you know?"
- "Do we have more shoes with laces or with sticky straps?"
- "Why do you think we have few shoes with buckles (laces, sticky straps)?"

Thank you for helping your child understand graphs.

What Kinds of Shoes Are in Our Home?



Shoes Templates

What Will We See on Our Walk?

BIG IDEA Probability

CURRICULUM EXPECTATIONS

Students will:

- use mathematical language in informal discussions to describe probability *(e.g., chance, never, sometimes, always)*.

MATERIALS

- picture cards made from ProbK.BLM1a–b: Picture Cards
- chart (on chart paper or the board) with three columns labelled "Will See", "Might See", and "Will Not See"
- tape or stick tack
- blank cards
- ProbK.BLM2: Always, Sometimes, and Never (1 per student)

ABOUT THE MATH

Students' early experiences with probability involve thinking about the likelihood of everyday events (e.g., considering whether an event always happens, sometimes happens, or never happens). In this activity, students predict the likelihood of seeing different objects during a school walk. The experience provides an opportunity for students to use language to describe probability (e.g., chance, might, probably).

GETTING STARTED

Tell students that the class will be going for a walk in the school building. Show each picture card from ProbK.BLM1a–b: Picture Cards, and ask: "Do you think we will see this on our walk?" Have students discuss the likelihood of seeing each object.

Display a chart (on chart paper or the board) with three columns labelled "Will See", "Might See", and "Will Not See". Show each picture card again, and ask students to decide in which column the card should be posted. Post each card using tape or stick tack. After all cards have been posted in the appropriate column, ask students to predict other things that they will see, might see, and will not see. On blank cards, draw the objects mentioned by students, and post the cards in the appropriate columns.

WORKING ON IT

Guide students on a school walk. Discuss whether their predictions of what they will see, might see, and will not see are correct. During the walk, ask questions that encourage students to use language to describe probability:

- "What will we certainly see in the gym? Why do you think we will see it?"
- "What do you think we might see? Why will we likely see it?"
- "What will we not see? Why do we never see it in the gym?"
- "What will we probably see outside the office?"
- "What will we probably not see?"

At the conclusion of the walk, ask: "Have we seen everything we predicted we would see? Did we see some things that we predicted we would not see?"

REFLECTING AND CONNECTING

Return to the classroom, and have students review the chart. Discuss whether their predictions were correct. Ask:

- "How did we know that we would see a _____?"
- "Why did we think that we might see a _____?"
- "How did we know that we would not see a _____?"

Encourage students to use language to describe probability, for example, "We knew that we would see a basketball hoop because there is *always* a basketball hoop in the gym. We knew that we would not see a giraffe because there is *never* a giraffe in the school."

ADAPTATIONS/EXTENSIONS

Kindergarten students vary in their ability to describe probability. It may be necessary to clearly model language, including vocabulary such as "always", "sometimes", and "never". Provide many opportunities throughout the year for students to discuss the probability of events in daily activities (e.g., the likelihood of having an indoor recess because of rainy weather).

To extend the activity, provide each student with three blank cards. Instruct students to draw a picture of something that they will always see on a school walk, a picture of something that they will sometimes see, and a picture of something they will never see. After students have completed their picture cards, gather students and show each card. Have students identify the object, and decide whether it belongs in the "Will See", "Might See", or "Will Not See" column of the chart.

MATH LANGUAGE

- language used to describe probability (e.g., might, probably, always, sometimes, never)

ASSESSMENT

Observe students to assess how well they make appropriate decisions about the likelihood of seeing objects during the school walk. Listen to the language they use to describe probability. Consider whether students use appropriate vocabulary (e.g., always, sometimes, never, might).

HOME CONNECTION

Send home ProbK.BLM2: Always, Sometimes, and Never. In this Home Connection activity, parents and students discuss and illustrate events that always, never, and sometimes happen at home. Provide an opportunity for students to share their pictures with classmates.

LEARNING CONNECTION 1

Probability Spinner

Materials

- spinner made from ProbK.BLM3: Probability Spinner, a paper clip, and a pencil (1 per pair of students)

Provide each pair of students with a copy of ProbK.BLM3: Probability Spinner, a paper clip, and a pencil. Instruct students to take turns spinning the spinner. After each spin, students read the word indicated by the spinner and tell their partners about an event that occurs always, never, or sometimes.

LEARNING CONNECTION 2

In Kindergarten I Might ...

Materials

- ProbK.BLM4: In Kindergarten I Might ... (1 per pair of students)
- crayons and pencils

Have students decide whether the following events are things they might do or would never do in Kindergarten:

- play a game
- eat a snack
- ride an elephant
- read a story
- eat 100 hot dogs

Ask students to give other examples of things that they might or would never do in Kindergarten.

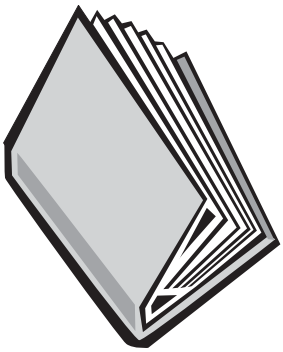
Tell students that they will work together to create a book entitled *In Kindergarten I Might*. Provide each pair of students with a copy of ProbK.BLM4: In Kindergarten I Might …. Explain that pairs of students are to discuss what they might and what they would never do in Kindergarten, record these ideas on their page, and illustrate the events. Give some examples:

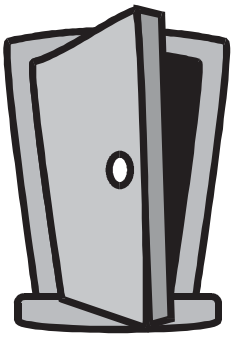
- In Kindergarten I might read a book, but I would never see a dinosaur.
- In Kindergarten I might play with a friend, but I would never drive a car.

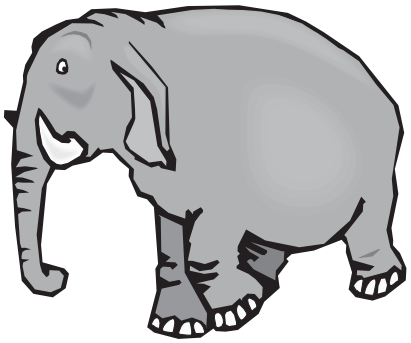
Consider organizing pairs of students so that one partner is able to complete the sentence stems on the page (e.g., using phonetic spelling). You might also have classroom volunteers (parents, older students) scribe students' ideas.

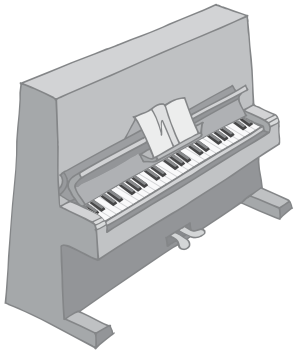
Assemble the completed pages to create a book, and read it to the class.

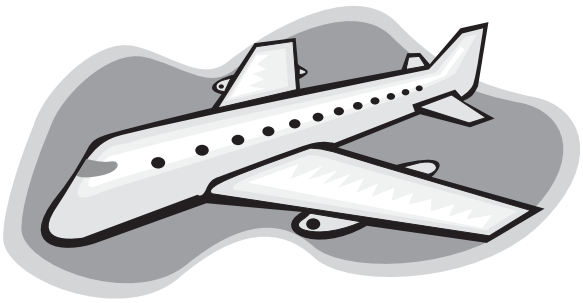
Picture Cards



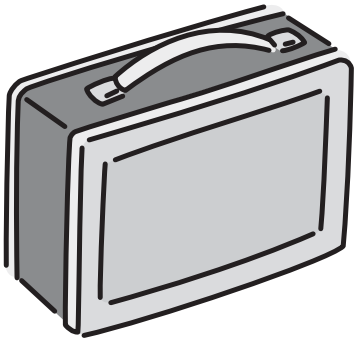


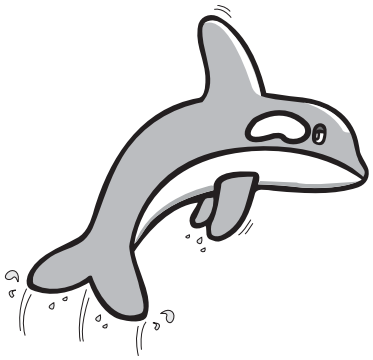






Picture Cards





Always, Sometimes, and Never

Dear Parent/Guardian:

Our class has been discussing the meaning of "always", "sometimes", and "never". We have been talking about things that we will **always** see in the school, things that we will **sometimes** see in the school, and things that we will **never** see in the school.

Discuss the meaning of "always", "sometimes", and "never" with your child. Ask him or her to identify events that always happen in your home every day, events that sometimes happen, and events that never happen.

Have your child draw pictures to show events that always, sometimes, and never happen. At school, students will talk with their classmates about their pictures.

Thanks you for helping your child understand the meaning of "always", "sometimes", and "never".

Always

Sometimes

Never

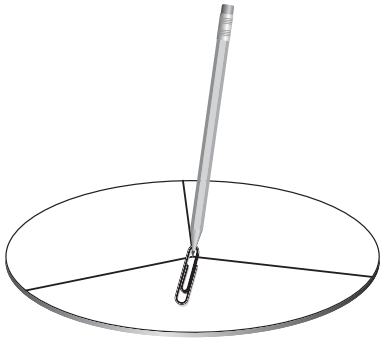
Probability Spinner

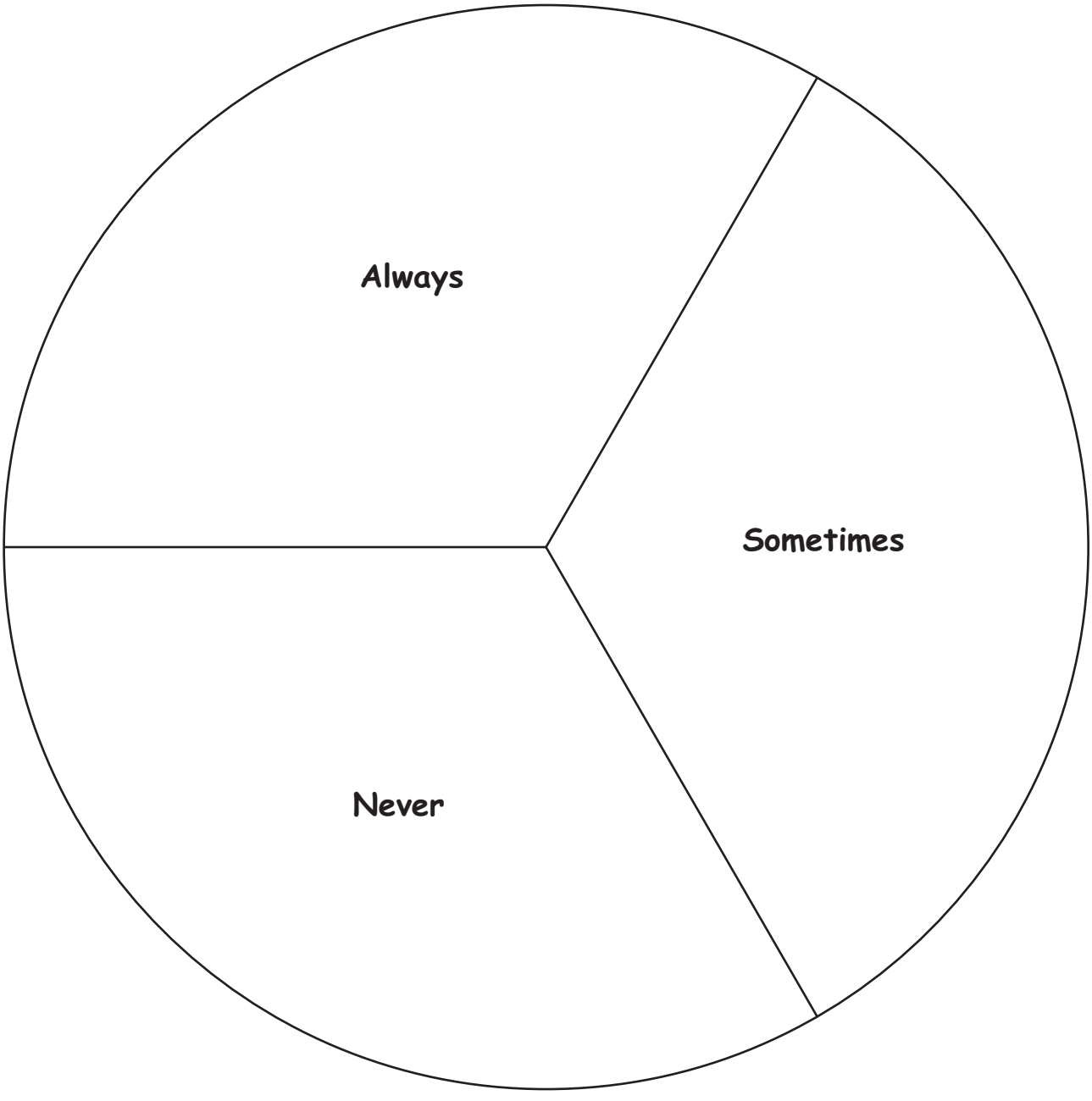
Spin the spinner.

What **always** happens?

What **sometimes** happens?

What **never** happens?





ProbK.BLM4

In Kindergarten I Might ...

In Kindergarten I might _____

_____

_____

_____

_____

_____

_____,

but I would never _____

_____

_____

_____

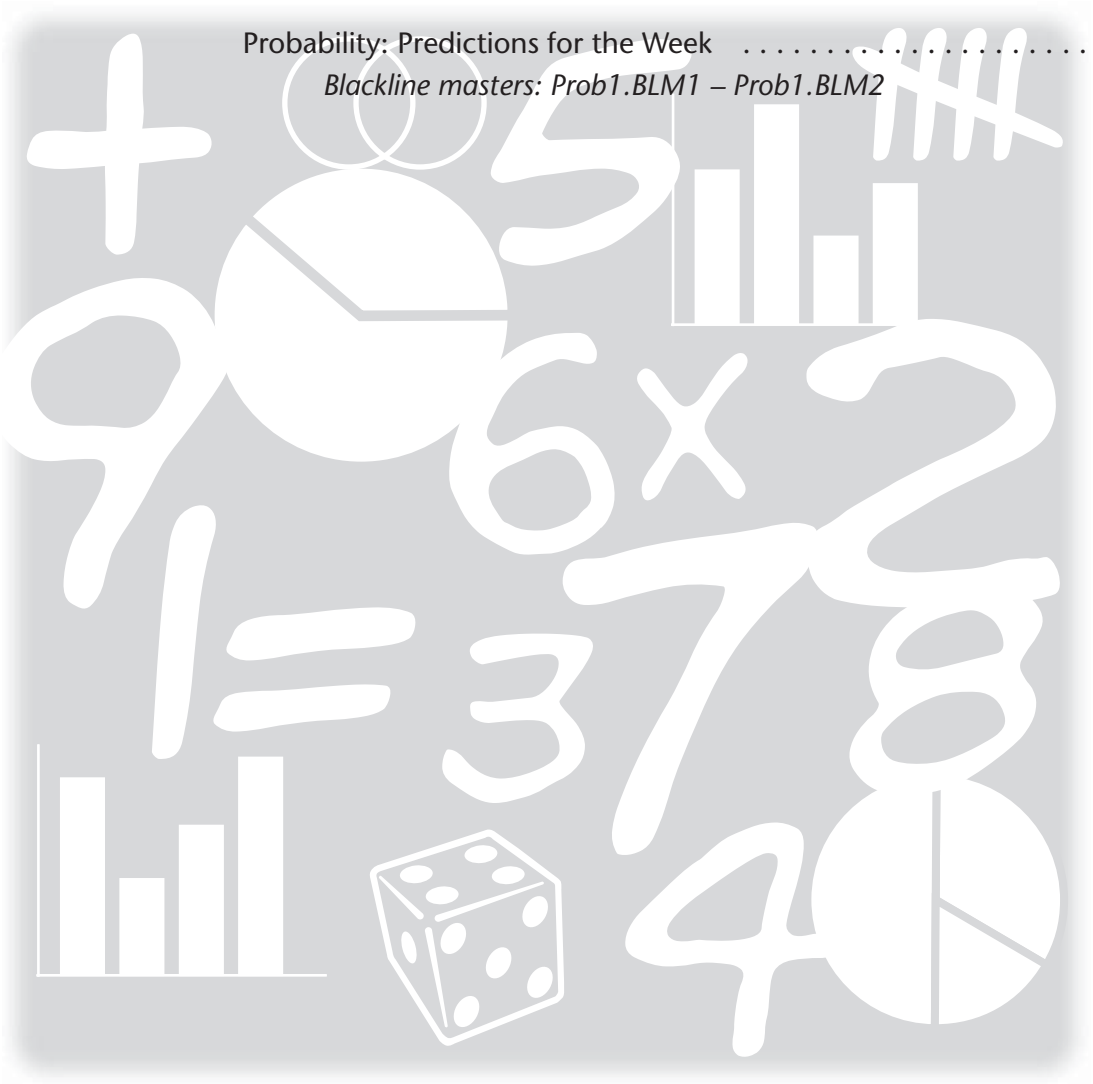
_____

_____

_____.

B. Grade 1 Learning Activities

Appendix Contents



Our Favourite Things

BIG IDEA **Collection and Organization of Data**

CURRICULUM EXPECTATIONS

Students will:

- collect and organize primary data (e.g., data collected by the class) that is categorical (i.e., that can be organized into categories based on qualities such as colour or hobby), and display the data using one-to-one correspondence, prepared templates of concrete graphs and pictographs (with titles and labels), and a variety of recording methods (e.g., arranging objects, placing stickers, drawing pictures, making tally marks);
- read primary data presented in concrete graphs and pictographs, and describe the data using comparative language (e.g., more students chose summer than winter as their single favourite season);
- pose and answer questions about collected data.

MATERIALS

- CO1.BLM1: What Is Your Favourite _____? (1 per student)
- blank sheets of paper
- crayons
- CO1.BLM2a–b: Creating a Graph at Home (1 per student)

ABOUT THE MATH

In Grade 1, students collect and organize data, and display the information in simple graphs. Classroom experiences should help students to understand that collection of data involves formulating a question (e.g., a survey question) that can be answered by gathering data. Students should have opportunities to make decisions about what survey question to ask, how to gather data (e.g., who answers the survey question), and how to organize the data (e.g., using a tally, drawing symbols beside students' names).

Guide students through processes involved in data collection and organization, without being overly prescriptive about how students complete the activity. For example, provide opportunities for students to develop their own survey questions, plan and carry out their data-collection methods, and make decisions about how to display the data. Given experiences in deciding how to collect and organize data, and observing the methods used by others, students learn about various ways to manage data effectively.

GETTING STARTED

Begin a discussion about favourite things by telling students the following story:

> "Saturday is my favourite day of the week. Last Saturday, I did a lot of favourite things. For breakfast, I had pancakes, my favourite breakfast food. Then I went for a long walk, which is one of my favourite outdoor activities. For lunch, I had my favourite sandwich. In the afternoon I visited my favourite aunt, and we played checkers, which is our favourite game. Because I was having a day with so many favourite things, I decided to make my favourite meal for dinner – I had spaghetti and meatballs. After dinner, I read my favourite book. I went to bed on Saturday night and thought about all the favourite things that filled my day."

Tell students that you are interested in knowing some of *their* favourite things. Have students respond to the questions, such as the following:

- "What is your favourite day of the week?"
- "What is your favourite breakfast food?"
- "What is your favourite outdoor activity?"
- "What is your favourite kind of sandwich?"

Suggest that the class create a book entitled *Our Favourite Things*. Discuss how students in the class could survey one another to learn about their favourite things, and how students could create graphs to display the survey results.

WORKING ON IT

Organize students into pairs. On the board, record "What is your favourite _____?" and ask pairs to decide what their survey question will be, for example, "What is your favourite game? What is your favourite fruit?" After pairs have decided on a survey question, record the different topics of students' survey questions on the board. If more than one pair of students creates the same survey question, allow students to change their topic.

Provide each pair with a copy of CO1.BLM1: What Is Your Favourite _____? Instruct students to complete the sentence stem at the top of the page. Next, ask them to predict their classmates' most popular choices, and to record these categories in the spaces at the bottom of the graph. (Some students may recognize the benefit of including an "Other" category; however, do not insist that students include this category – it is better that they learn through experience that an "Other" category is an important option in some surveys.)

Encourage pairs to make a plan before they begin to survey classmates. Ask them to think about how they can ensure that all students in the class answer the survey

question, avoid asking students more than once, and record the survey data in an organized way.

Note: If students have had many opportunities to collect and organize data, they might be ready to do this activity without using the template on CO1.BLM1: What Is Your Favourite _____? If conducting a survey with the entire class is difficult for students, have them survey a smaller group of students.

Provide time for students to survey their classmates and to collect the data. Students might organize the data by using tally marks, recording symbols beside students' names, or colouring spaces on the template on CO1.BLM1: What Is Your Favourite _____? Observe the methods used by students and provide guidance when needed.

Encourage students to prepare graphs that will be easy for others to understand. Suggest that they use the template on CO1.BLM1: What Is Your Favourite _____? or create their own graph on a different sheet of paper. Have students record a sentence about the data below their graph.

REFLECTING AND CONNECTING

Assemble students after they complete their graphs, and have some pairs of students present their work. Ask students to explain what they learned about their classmates' favourite things.

Ask questions that encourage students to reflect on the methods they used to collect and organize data:

- "What was your survey question?"
- "How did you make sure that everyone answered the question?"
- "How did you make sure that you did not ask the same person more than once?"
- "How did you record the data?"
- "How did you create a graph?"
- "What was easy for you to do?"
- "What was difficult to do?"
- "When you collect data for a survey question next time, is there something you might do differently? Why?"
- "What did you learn about collecting and organizing data?"

Post students' pages after they present their work. Discuss the similarities and differences among the different graphs. Ask students to look at the work samples and to decide which graphs are easy to understand. Have students explain characteristics of graphs

that are easy to read (e.g., labels are clearly recorded, graph includes title and labels, work is neat).

Assemble students' work to create a book. Invite students to read the book to learn more about their classmates' favourite things.

ADAPTATIONS/EXTENSIONS

Some students may require support in collecting and organizing data. Consider student pairings – you may want to pair students experiencing difficulties with a classmate who is able to provide guidance throughout the activity.

If students have difficulty managing a large set of data, have them survey a small group of students (e.g., 10 students) rather than the entire class.

Extend the activity for students requiring a greater challenge by having them complete the activity without using the template on CO1.BLM1: What Is Your Favourite _____? Ask these students to create their own graphs to show the data they collected. Have these students record information about the data in their graphs.

MATH LANGUAGE

- data
- collect
- organize
- survey question
- graph
- tally

ASSESSMENT

Observe students to assess how well they:

- select appropriate categories for their surveys;
- collect and organize data;
- create graphs to display data;
- make observations about the data.

HOME CONNECTION

Send home CO1.BLM2a-b: Creating a Graph at Home. This Home Connection activity provides an opportunity for students to create a graph about objects at home, and to discuss the graph with a parent.

LEARNING CONNECTION 1

Block Graphs

Materials

- CO1.BLM3: Block Template (1 per student)
- scissors
- pencils
- crayons
- glue

Provide each student with a copy of CO1.BLM3: Block Template. Help students to read the titles in each section of the template (Favourite Fruit, Favourite Toy, Favourite Animal, and so on).

Instruct students to draw and colour a picture to show their favourite fruit, toy, animal, and so on, in the appropriate section of the template. Have students label their pictures.

Help students to cut out the block templates, fold on the dotted lines, and construct the blocks, using glue.

After the glue is dry, have students show their blocks to the class, and explain their pictures of favourite things.

Together, sort the blocks into groups according to favourite fruit. For example, create a group of blocks showing apples (arranging the blocks so that the pictures of apples are on the top face of the block), a group of blocks showing oranges, a group of blocks showing bananas, and so on. Next, stack the blocks to create a concrete graph.

Ask questions, such as the following:

- "Which kind of fruit did most students choose as their favourite?"
- "Which kind of fruit did the fewest students choose as their favourite?"
- "Did more students choose apples or oranges?"
- "How many more students chose apples than chose bananas?"

Repeat by having students sort their blocks according to other categories of favourite things (e.g., toys, animals, snacks). Create concrete graphs using the blocks, and discuss the information shown in the graphs.

LEARNING CONNECTION 2

Mystery Person

This game helps students to think about various characteristics of classmates, and provides an opportunity to demonstrate the use of a tally as a useful tool for collecting and organizing data.

Have the class stand. Tell students that you have chosen a Mystery Person. Explain that students are to ask questions that will help them find the Mystery Person, but that the answer to the questions must be either "yes" or "no". Provide examples of questions, such as "Is the Mystery Person a boy?" "Does the Mystery Person wear glasses?" "Does the Mystery Person have a sister?" Remind students that the questions they ask must not hurt others' feelings (e.g., by asking a question that might embarrass a classmate).

Tell students that you will keep track on the board of the number of questions they ask before identifying the Mystery Person.

Have individual students ask their questions. Answer "yes" or "no" to students' questions. For each answer, record a tally mark on the board.

From time to time, review the characteristics of the Mystery Person that have been identified. Have students find the number of questions asked by referring to the tally on the board.

After playing the game a few times, challenge students to identify the Mystery Person using 20 questions or fewer.

LEARNING CONNECTION 3

Secret Sorting Rule

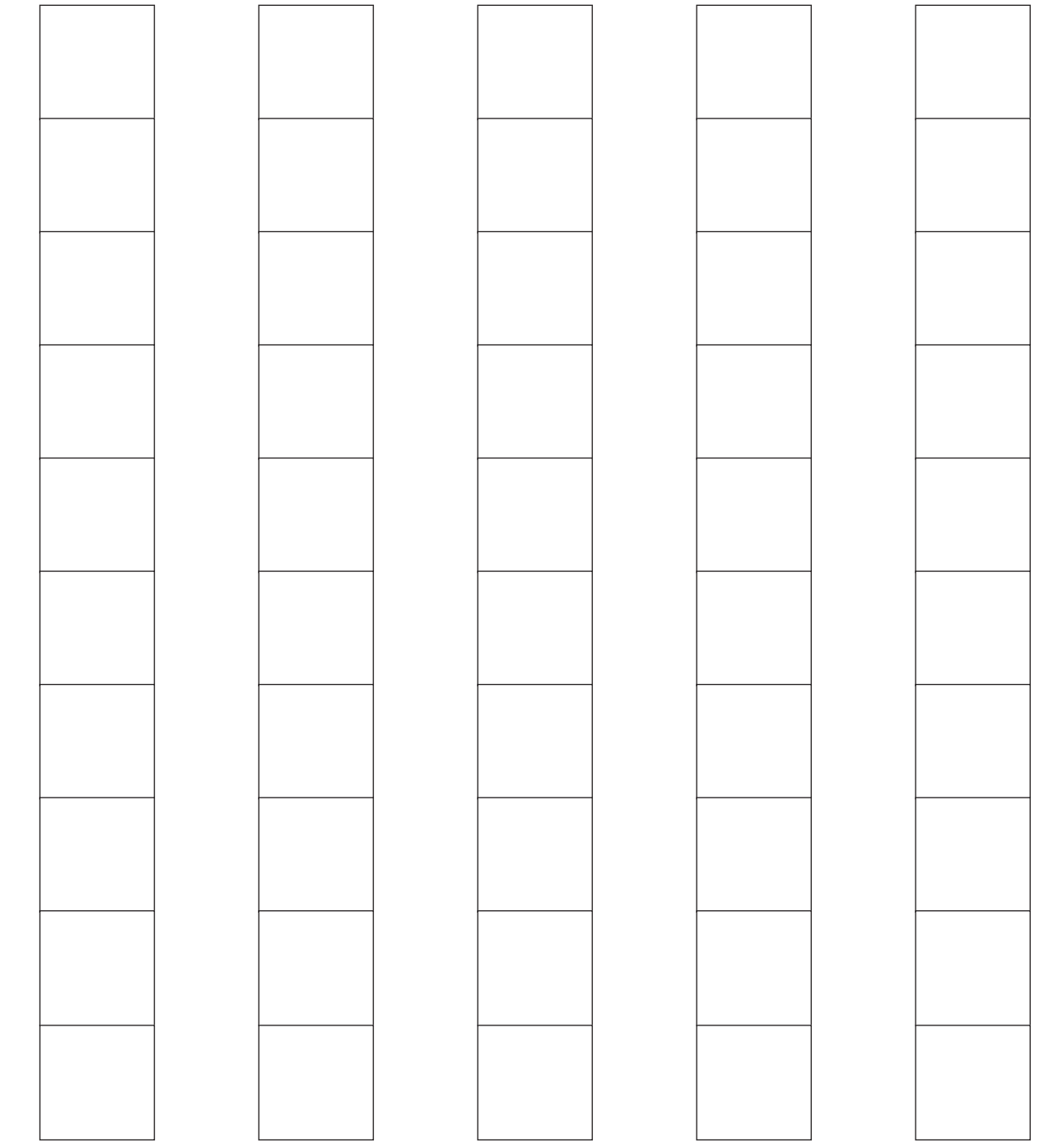
Tell the class that you are going to sort students according to a secret sorting rule, and that they need to figure out the rule. Ask three or four students who share a common attribute (e.g., having brown eyes, having blond hair, wearing glasses, wearing jeans) to stand in a group. Tell the class that these students have something in common. Next, choose three or four students who do not share the attribute, and ask them to form another group. Tell the class that these students do not fit the secret rule.

Ask students to observe the two groups of students and try to find the sorting rule. Test students' conjectures by having students check whether only students in the first group possess the given attribute. Continue to have students join either group until the class is able to identify the sorting rule.

Repeat the activity by sorting students according to other secret sorting rules. Have students take on the role of the secret sorter.

What Is Your Favourite _____?

CO1.BLM1



_____ _____ _____ _____ _____

Creating a Graph at Home

Dear Parent/Guardian:

Our class has been busy making graphs. We are learning that graphs are helpful in showing information.

Provide an opportunity for your child to create a simple graph about objects in your home. For example, your child could create a graph that shows the number of:

- forks, knives, and spoons;
- cups, saucers, and bowls;
- pens, pencils, and erasers; or
- shoes, socks, and boots.

There should be 10 or fewer of any one item.

Have your child create the graph using the attached page. Help your child record a title and labels on the graph.

Ask your child questions about the graph:

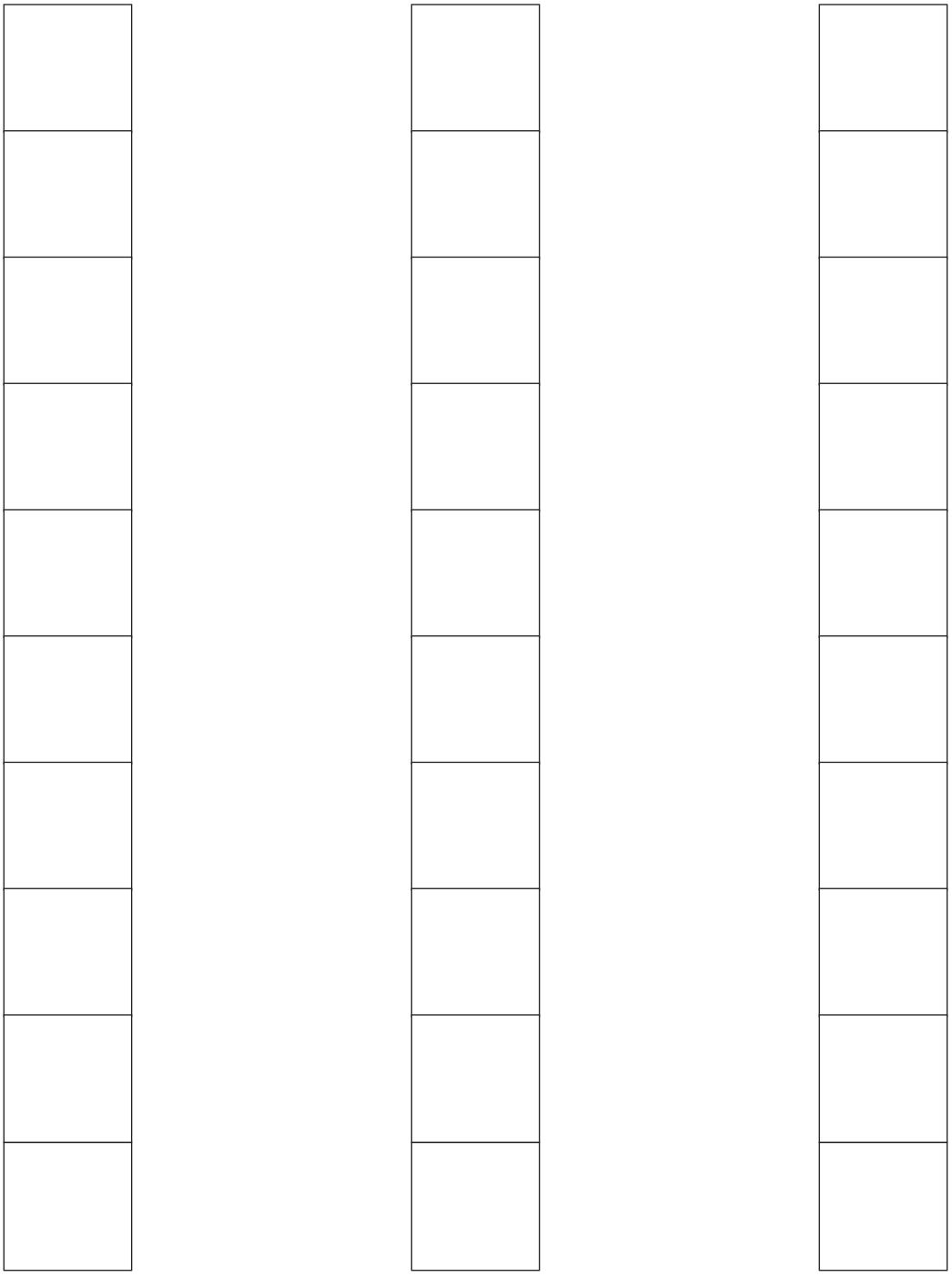
- What does your graph show?
- How many _____ does your graph show?
- Are there more _____ or _____?

Thank you for helping your child create a graph about things in your home.

CO1.BLM2b

Creating a Graph at Home

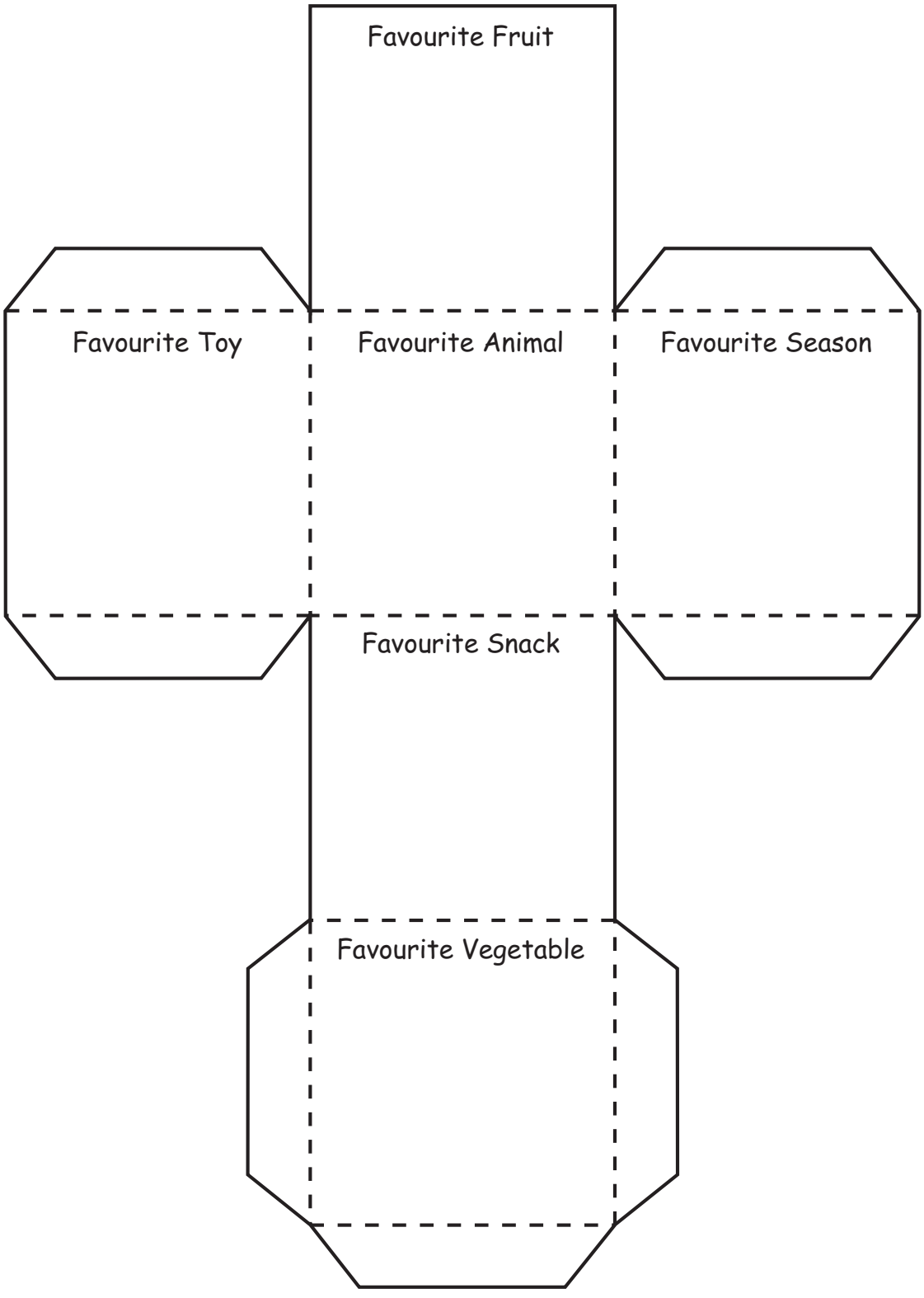
Title: _____



_____ _____ _____

Block Template

CO1.BLM3



A Day of Favourite Activities

BIG IDEA **Data Relationships**

CURRICULUM EXPECTATIONS

Students will:

- collect and organize primary data (e.g., data collected by the class) that is categorical (i.e., that can be organized into categories based on qualities such as colour or hobby), and display the data using one-to-one correspondence, prepared templates of concrete graphs and pictographs (with titles and labels), and a variety of recording methods (e.g., arranging objects, placing stickers, drawing pictures, making tally marks);
- read primary data presented in concrete graphs and pictographs, and describe the data using comparative language (e.g., more students chose summer than winter as their single favourite season);
- pose and answer questions about collected data.

MATERIALS

- collection of students' favourite storybooks
- interlocking cubes (1 per student)
- other ways to show their choices (sticky notes, pictures symbols, cards)
- DR1.BLM1: Activities for Favourites Day (1 per group of 3 students)
- DR1.BLM2: Graphs for Favourites Day (1 per student)

ABOUT THE MATH

In Grade 1, students collect and organize data using concrete graphs and pictographs. Experiences with such graphs allow students to observe that data can be categorized and that the amount of data in different categories can be compared. By making these comparisons, students can reach conclusions about the information presented in graphs.

In this learning activity, students create simple graphs by voting for their favourite storybook, game, and song. Students examine the data displayed in the graphs in order to make decisions about activities for a special Favourites Day.

GETTING STARTED

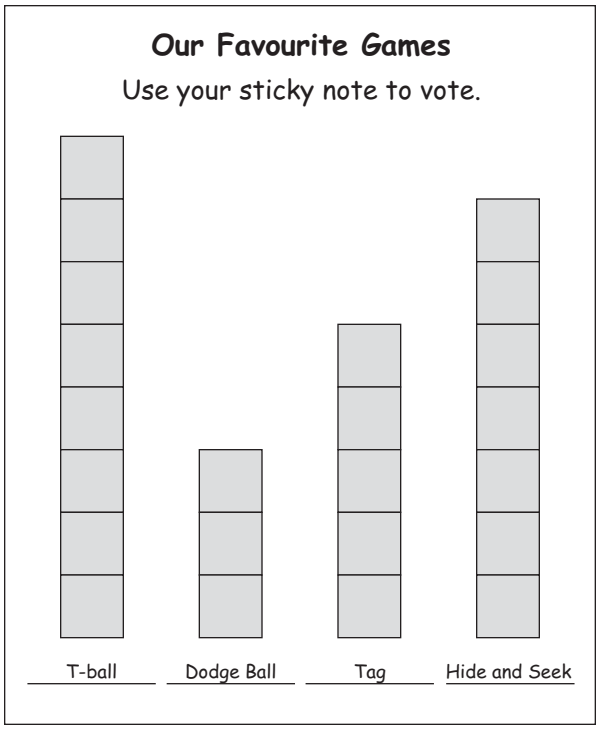
Explain the following to the class:

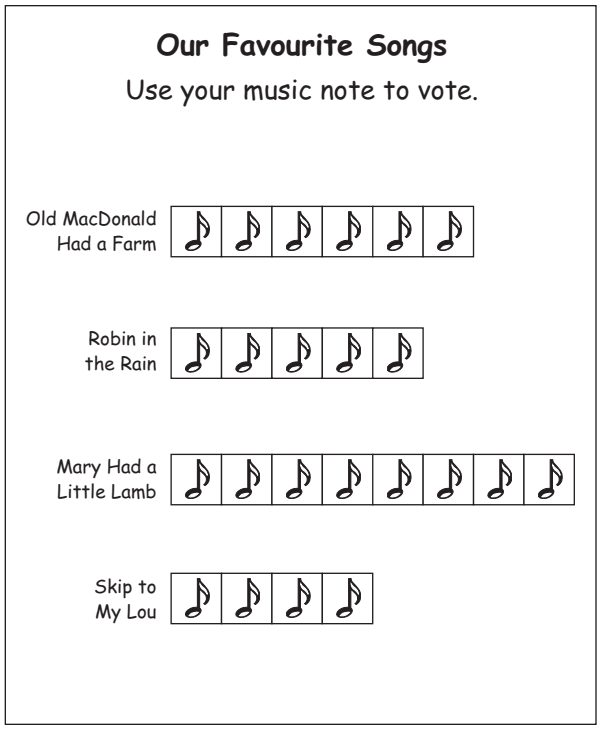
> "In a few days, our class will have a special Favourites Day when we will enjoy some of our favourite activities, such as reading a favourite story, playing a favourite game, and singing a favourite song. To help us decide what we should do on our special day, we need to collect and examine information about our favourite activities. We will identify a few favourite activities, and then everyone will have a chance to vote for his or her favourite activities. On our special day, we will do the activities that receive the most votes."

Show students a collection of familiar storybooks. Ask students to identify three or four favourite storybooks in the collection, and display these books on a ledge. Next, give each student an interlocking cube, and ask students to place their cubes next to the story they would like to listen to. Snap together the cubes that are beside each book, and stand each column of cubes next to the corresponding book.

Guide students in selecting a favourite game and song for the special day:

- Have students identify three or four possible choices.
- Have students vote for their choice. Use a different data-collection method each time. (See suggestions illustrated in the diagram below).
- Display the data for students to use in Working On It.





WORKING ON IT

After students have voted for their choice of activities, tell them you need their help in deciding which activities to do on Favourites Day. Divide students into groups of three, and provide each group with a copy of DR1.BLM1: Activities for Favourites Day. Explain that each group needs to complete the report by looking at the data that have been collected. Encourage students to take turns recording information on the sheet.

As students are working, ask questions, such as the following:

- "How does the information in the graphs help you decide which activities the class should do?"
- "According to the graph, which song should we sing? Why?"
- "If we sing two favourite songs, what should they be? Why?"
- "Which song should we not sing? Why?"
- "What will you recommend in your report?"

REFLECTING AND CONNECTING

Reconvene the class after groups have completed DR1.BLM1: Activities for Favourites Day. Comment that you would like to hear reports from different groups to see whether students agree on which activities to do on Favourites Day.

Have different groups read their reports on "A Story for Favourites Day". Ask groups to explain how they made decisions for their report. Discuss whether groups have all chosen the same story, and talk about reasons why groups might not agree. (Some students might ignore the most popular choice shown in the graph if they prefer a different story.)

Continue the discussion by having groups present their reports about games and songs for Favourites Day. Emphasize the idea that graphs provide information that can be used to make decisions.

At a later date, hold a Favourites Day during which you provide opportunities for students to enjoy their favourite activities.

ADAPTATIONS/EXTENSIONS

Some students may have difficulty comparing data presented in the graphs (e.g., the number of students who chose one book compared with the number who chose a different book). Encourage these students to examine the graphs closely and to count the number of cubes, sticky notes, picture cards, and so on, in each section of the graph. Ask students questions that help them to compare, such as "Which bar in this graph is the longest?" "Why is this bar longer than this bar?"

Completing DR1.BLM1: Activities for Favourites Day may be challenging for some students. Have these students work with classmates who can help them to record their ideas.

Extend the activity by having students suggest other kinds of activities for Favourites Day (e.g., doing a favourite math activity, doing a favourite craft). Have them collect data using a method that makes sense to them, and invite them to write a report to explain their findings.

MATH LANGUAGE

- concrete graph
- pictograph
- data
- many, most, more
- few, fewer, fewest
- less, least

ASSESSMENT

Observe students to assess how well they:

- compare data in concrete graphs and pictographs;
- describe data presented in concrete graphs and pictographs;
- use data presented in concrete graphs and pictographs to make decisions and reach conclusions.

HOME CONNECTION

DR1.BLM2: Graphs for Favourites Day encourages parents and students to discuss how the class created and examined graphs in preparation for Favourites Day. This discussion allows students to review the learning activity and to reflect on how graphs display information that can help in decision making.

LEARNING CONNECTION 1

What Play Equipment Do You Choose?

Materials

- 3 to 5 different kinds of play equipment (e.g., balls and scoops, basketballs, skipping ropes, bean bags, hoops)

Show students different kinds of play equipment. Tell them that they will choose the kind of equipment to play with at recess.

Place the different pieces of play equipment in a row. Instruct student to choose one kind of equipment and form a line behind their choice.

After all students are in a line, ask the following questions:

- "How did we create a graph?"
- "Why could we call this kind of graph a people graph?"
- "Where are the data in our graph?"
- "What do the data show?"
- "How could we create a different kind of graph that shows the same information as our people graph?"

Provide an opportunity for students to play with the equipment.

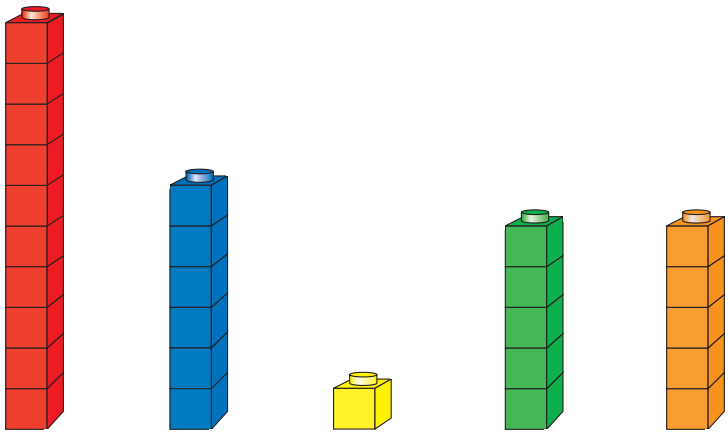
LEARNING CONNECTION 2

Favourite Colours

Materials

- container of interlocking colour cubes

Pass around a container of interlocking colour cubes, and invite all students to take a cube that represents their favourite colour. Collect the cubes from students, one colour at a time, and connect them to create a bar. Place the bars of colour cubes upright on a ledge of the board to create a concrete graph.



Ask questions that allow students to compare data represented in the concrete graph:

- "What is the favourite colour of most students? How do you know?"
- "What is the least favourite colour? How do you know?"
- "How many students chose red as their favourite colour?"
- "Did more students choose green or yellow?"

Have students count the number of cubes in each bar, and record the numbers on the board beside the bars of cubes. Take apart the bars and return the individual cubes to the container.

Ask: "Is you favourite colour *always* your favourite colour? What colour would you choose if you could paint the walls in your bedroom?" Pass around the container of cubes again, and ask students to select a cube to show their choice of paint colour. Construct a concrete graph, using the cubes. Ask:

- "What is the favourite paint colour of most students? How do you know?"
- "What is the least favourite paint colour? How do you know?"
- "How many students chose red as their favourite paint colour? Does this match the information we gathered earlier about red as a favourite colour?"
- "How is this graph different from the graph we made earlier?"

Repeat the activity by creating and comparing concrete graphs for different questions, such as "What colour would you choose for a new pair of jeans? a new bike? a new stuffed animal?" Discuss how the graph changes (e.g., the colours chosen by most students) depending on the meaning of the graph.

DR1.BLM1

Activities for Favourites Day

A Story for Favourites Day

We should read _____.

Another popular choice is _____.

We should not read _____.

A Game for Favourites Day

We should play _____.

Another popular choice is _____.

We should not play _____.

A Song for Favourites Day

We should sing _____.

Another popular choice is _____.

We should not sing _____.

Graphs for Favourites Day

Dear Parent/Guardian:

Our class will be having a Favourites Day. On that day, students will have an opportunity to hear a favourite story, play a favourite game, and sing a favourite song.

Students have participated in making decisions about activities for Favourites Day by making simple graphs, and examining the information presented in the graphs.

Ask your child to tell you about these learning experiences. Here are some questions you might ask:

- Which storybooks did your classmates pick as their favourites?
- How did you make a graph to help you decide which story to read on Favourites Day?
- How did students vote to choose a story?
- What other kinds of graphs did you make for Favourites Day?
- How did students vote to choose a favourite game?
- How did students vote to choose a favourite song?

To help your child explain the graphs, encourage him or her to draw simple pictures of the graphs.

Thank you for discussing the graphing experiences with your child.

Predictions for the Week

BIG IDEA **Probability**

CURRICULUM EXPECTATIONS

Students will:

- describe the likelihood that everyday events will occur, using mathematical language (i.e., *impossible*, *unlikely*, *less likely*, *more likely*, *certain*) (e.g., "It's unlikely that I will win the contest shown on the cereal box.").

MATERIALS

- chart on chart paper with four columns labelled "Certain", "Likely", "Unlikely", and "Impossible"
- cards cut from Prob1.BLM1a–c: Event Cards
- glue
- Prob1.BLM2: Certain, Likely, Unlikely, and Impossible (1 per student)

ABOUT THE MATH

Young students begin to develop concepts about probability as they consider the likelihood of events in their daily lives. Initially, they describe the likelihood of events using simple language, such as "That couldn't happen," "My mom might take me to see my grandma," "I know that I'll lose my tooth soon."

Classroom activities can help to develop students' growing intuitions about chance, and can help them to acquire language to describe ideas about probability more precisely. These learning experiences can provide opportunities for students to think about the meaning of vocabulary such as "unlikely", "likely", and "certain", and allow them to use these terms in relation to everyday events.

GETTING STARTED

At the beginning of a school week, discuss events that will occur in the classroom in the next few days.

> "There will be lots of things happening in our classroom this week. We will be reading stories, singing songs, doing math activities, playing games at recess, and learning lots of new things."

Continue the discussion by talking about events that might happen and those that will not happen

"This week, some things *might* happen. We might have a visitor in our classroom. Maybe a guest will come and read a story to us. Perhaps we will play a game in the gym.

"I know that there are some things that will not happen this week. We will not be meeting with our reading buddies on Wednesday because they will be on a class trip. I also know that we will not sing 'Happy Birthday', because no one in our class has a birthday this week."

Ask students to suggest other events that will, might, and will not occur during the upcoming week.

WORKING ON IT

Display a chart with four columns labelled "Certain", "Likely", "Unlikely", and "Impossible". Read the headings together, and ask students to explain what they mean.

Show the cards made from Prob1.BLM1a–c: Event Cards, and explain that students will need to predict whether the event written on each card will occur in the classroom during the upcoming week. Read each card aloud, and ask questions, such as:

- "Do you think this event will happen this week? Why or why not?"
- "Do you think this event is *certain* this week, *likely*, *unlikely*, or *impossible*? Why?"
- "In which column of the chart should we post this card?"

Glue each card in its appropriate column. Allow students to discuss their differences of opinion about the likelihood of any event. If there is no consensus, make a copy of the event card, and post the event in more than one column.

Note: Decide whether it is more appropriate to complete this activity as a large group or with small groups of students. If students work in small groups, provide each group with a set of event cards cut from Prob1.BLM1a–c: Event Cards, a sheet of chart paper divided into four columns, and glue. Instruct students to work together as they read the cards, discuss the likelihood of events, and glue the cards in appropriate columns.

After all event cards have been glued to the chart, discuss the activity:

- "Why is this event in this particular column?"
- "Was it easy to decide where to place this event? Why or why not?"
- "Which event was difficult to place? Why?"
- "How can we know that our predictions are correct?"

Explain to students that you will be leaving the chart up for the week, and later the class will check whether the predictions were correct.

From time to time, during the next few days, refer to the chart and discuss how specific events have or have not occurred.

REFLECTING AND CONNECTING

At the end of the week, review the chart with students. Ask questions, such as the following:

- "Why did we place this card in this column at the beginning of the week? Did we place this card in the right column? Why or why not?"
- "Which predictions came true? Why do you think we predicted correctly?"
- "Which predictions did not come true? Why do you think we predicted incorrectly?"
- "How would you change the chart if you made predictions for next week?"
- "Will the events in the 'Impossible' column *always* be impossible, or could some of them become possible?"
- "Will the events in the 'Unlikely' column *always* be unlikely, or could some of them become likely?"

Listen to students as they respond to questions in order to assess their understanding of "certain", "likely", "unlikely", and "impossible", and their ability to describe the likelihood of events using appropriate language.

ADAPTATIONS/EXTENSIONS

Recognize that students' understanding of chance and their ability to describe the likelihood of events depend on their experiences in and out of school. Some students may have had little opportunity to discuss ideas about probability, so it is important to emphasize the meaning of words such as "certain", "likely", "unlikely", and "impossible", and to talk about examples of these terms. If the activity is completed by small groups of students, ensure that students who have an emerging understanding of probability work with classmates who can discuss and explain the likelihood of events.

Extend the activity by having students create their own classroom event cards. Students can create the cards using words and/or pictures. Encourage students to create cards that show impossible, unlikely, likely, and certain events. Have students categorize their events in a chart.

MATH LANGUAGE

- certain
- likely
- unlikely
- impossible
- chance

ASSESSMENT

Observe students to assess how well they:

- categorize events as impossible, unlikely, likely, or certain;
- explain the likelihood of events;
- describe the likelihood of events using appropriate language (e.g., *impossible*, *unlikely*, *likely*, *certain*, *will*, *might*, *could*, *chance*).

HOME CONNECTION

Send home Prob1.BLM2: Certain, Likely, Unlikely, and Impossible. This Home Connection activity provides an opportunity for parents and students to discuss the likelihood of events at home.

LEARNING CONNECTION 1

When I Grow Up ...

Materials

- chart paper
- paper (1 sheet per student)
- crayons

Ask students to tell the class their predictions about what they will be doing when they grow up (e.g., where they might be living, what job they might have, what they might enjoy doing). Ask questions that help students think about and describe the likelihood of their predictions:

- "Why is it likely that you will have that job?"
- "Is it possible that you might have a different job? Why?"
- "Is it certain that you will live there?"
- "Are you more likely to live in the country or in the city? Why?"

Discuss how the likelihood of having certain jobs in the future depends somewhat on students' interests. For example, becoming a veterinarian is more likely for someone who has an interest in caring for animals, and less likely for someone who is afraid of animals.

Give each student a sheet of paper folded in half horizontally. Record the following sentence stems on the board or chart paper:

- When I grow up, it is likely that I …
- When I grow up, it is unlikely that I …

Have students record and complete the first sentence stem in the top section of their page, and the second sentence stem in the bottom section. Ask students to illustrate their ideas.

Compile the pages to create a class book. Read the book together.

LEARNING CONNECTION 2

Likely or Unlikely?

Have students consider the likelihood of events. Instruct them to listen to the statements you give, and to show a thumbs-up gesture if the event is likely, or a thumbs-down gesture if the event is unlikely. Announce statements, such as the following:

- "You will walk home after school."
- "You will take a bus after school."
- "You will play outside after school."
- "You will go to the circus after school."
- "You will read a book this evening."
- "You will watch TV this evening."
- "You will play with a pet monkey this evening."
- "You will go to bed before 8 p.m."

Event Cards

Prob1.BLM1a

We will read a story.
We will sing a song.
We will go skating.
We will have recess.
We will go to the library.

Event Cards

Prob1.BLM1b

Half the class will be absent.
We will play a game.
We will eat lunch.
We will see a spider.
We will go to the gym.

Event Cards

Prob1.BLM1c

We will paint the walls.
We will have a visitor.
We will ride a camel.
We will jump onto the roof.
We will write a story.

Certain, Likely, Unlikely, and Impossible

Dear Parent/Guardian:

We have been learning about probability in math class. We have discussed how events at school can be certain, likely, unlikely, or impossible. Here are some examples:

- Certain: We will have recess.
- Likely: We will write a story.
- Unlikely: Half the class will be absent.
- Impossible: We will jump onto the roof.

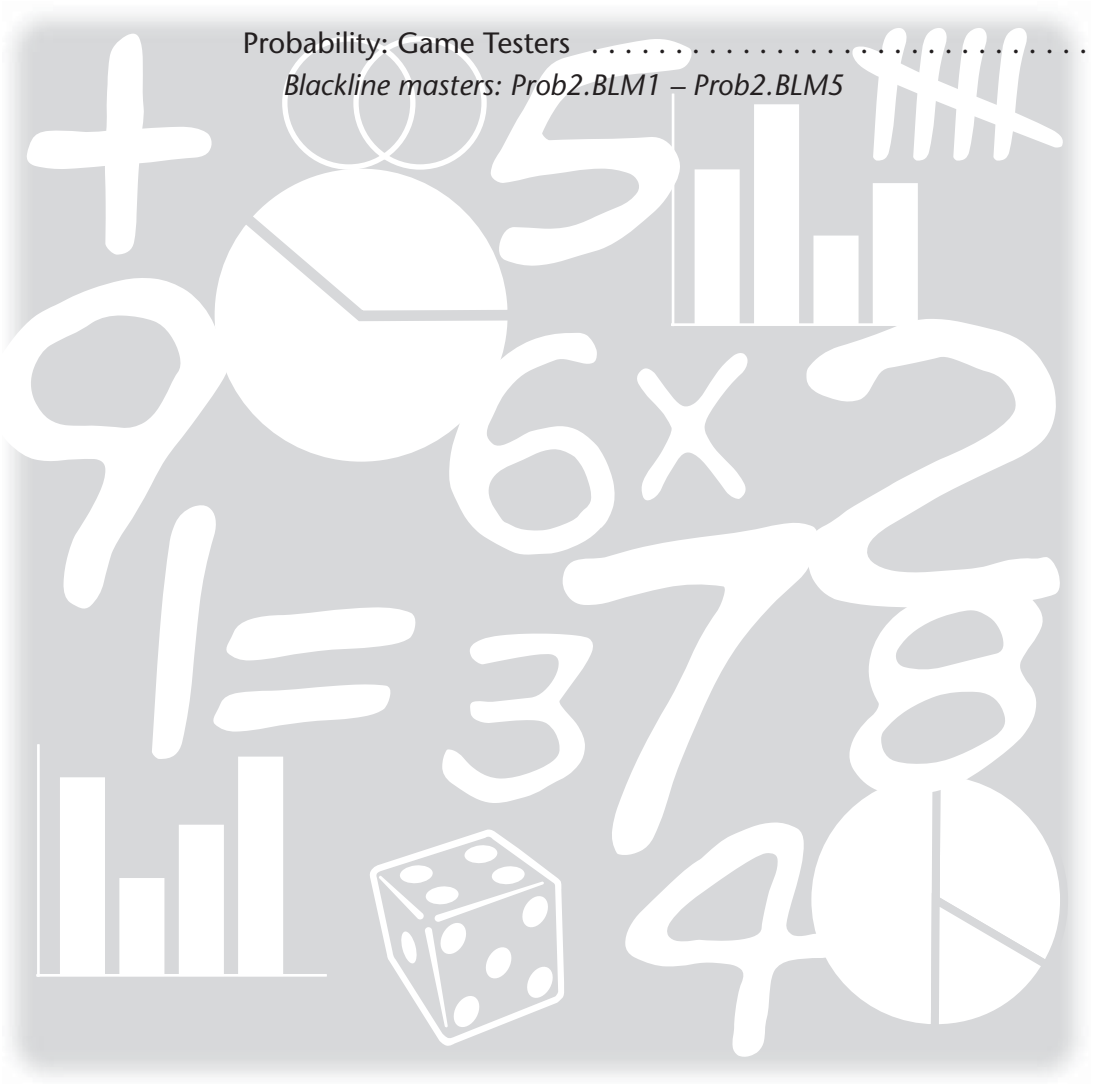
Discuss events in your home that are certain, likely, unlikely, and impossible. Ask your child to draw a picture in each space below.

Thank you for discussing ideas about probability with your child.

Certain	**Likely**
Unlikely	**Impossible**

C. Grade 2 Learning Activities

Appendix Contents



Party Packs

BIG IDEA ***Collection and Organization of Data***

CURRICULUM EXPECTATIONS

Students will:

- read primary data presented in concrete graphs, pictographs, line plots, simple bar graphs, and other graphic organizers (e.g., tally charts, diagrams), and describe the data using mathematical language;
- gather data to answer a question, using a simple survey with a limited number of responses (e.g., What is your favourite season?; How many letters are in your first name?);
- collect and organize primary data (e.g., data collected by the class) that is categorical or discrete (i.e., that can be counted, such as the number of students absent), and display the data using one-to-one correspondence in concrete graphs, pictographs, line plots, simple bar graphs, and other graphic organizers (e.g., tally charts, diagrams), with appropriate titles and labels and with labels ordered appropriately along horizontal axes, as needed.

MATERIALS

- small paper bags, each containing 5 small gift items (1 bag per group of 3 students); inexpensive gift items, such as party favours, colourful pencils, small toys, and stickers, can be purchased at dollar stores. Alternatively, use pictures cut from CO2.BLM1a–b: Gift Items, instead of actual gift items.
- chart paper
- CO2.BLM2: Graph Template (1 per group of 3 students)
- sheets of lined paper (1 per group of 3 students)
- CO2.BLM3: Survey Questions (1 per student)

ABOUT THE MATH

Data management activities often require students to conduct a survey. Students need to recognize that surveys involve more than asking the same question of every classmate and creating a graph with the survey results. Instead, they should understand that surveys provide a means for collecting information from a group of people, and that this information provides a basis on which decisions can be made. It is important that students see that the ways in which this information is displayed in graphs can help in decision making.

In this activity, students conduct a survey with a purpose: to help a company make decisions about which items to put in party bags. They create graphs using the data collected in the survey and make recommendations to the company managers.

GETTING STARTED

Explain the following scenario to the class:

> "The Party Pack Company sells small gift bags for special celebrations, such as holidays, weddings, and birthdays. These gift bags contain a few treats to eat and a few little presents. People buy the bags to give to their guests as a special gift.
>
> "The Party Pack Company's managers are planning to create small gift bags for children's birthday parties. They want to put gifts in the bags that children will really like. So here is how you can help them: they would like you to collect data that will help the company managers decide which gifts to include in the bags."

Show students sample gift bags. Explain that the company managers have put five small gifts into each sample bag, but that they want to include only three of the five gifts in a bag. Tell students that the class will conduct a survey to determine which three gifts in each sample bag are the most popular. After collecting data from the survey, groups will present their findings.

WORKING ON IT

Divide students into groups of three. Provide each group with a bag containing five small gift items. Then complete the activity:

- Have each group conduct a survey by showing the five gift items to each of their classmates individually and asking them to choose their favourite item. (The survey should involve all classmates.)
- Ask groups to record the results from the survey (e.g., by keeping their own tally chart).
- Have each group discuss the findings from the survey (e.g., using their tally chart).
- Ask each group to create a graph on CO2.BLM2: Graph Template to show the results of the survey. Groups may choose not to use CO2.BLM2: Graph Template to create their graph.
- Finally, have each group write a letter, on a sheet of lined paper, to the managers of the Party Pack Company, explaining its findings and recommendations.

Observe the processes used by students to collect and organize data, and provide guidance when needed. After students have gathered data, ask them questions, such as the following:

- "How did you collect data about the gifts students like?"

- "How did you know if you asked all students your survey question?
- "How did you record information gathered in the survey?"
- "What do the survey results show?"
- "How can you create a graph that shows the results of your survey?"
- "What will you explain to the managers of the Party Pack Company about the results of your survey? What will you recommend?"

Provide time for groups to complete their graphs and write their letters. Record the following outline on the board or chart paper to assist students in writing their letters.

To the Managers of the Party Pack Company:

We found that _____
_____
_____.

We recommend that _____
_____
_____.

We hope that this information is helpful.

Sincerely,

REFLECTING AND CONNECTING

Gather students together. Begin the discussion by having different groups explain how they conducted the survey and recorded survey results. After discussing the methods used by students, ask:

- "How did a survey help you collect the information you needed?"
- "What are important things to think about when you conduct a survey?"
- "How can you keep track of who has answered the question and who has not?"
- "What are good ways to record survey results?"
- "If you were to conduct the survey again, what would you do differently? Why?"

Next, ask groups to show their graphs, explain what the graphs show, and read their letters to the company managers. Ask each group questions, such as the following:

- "What gift was chosen by most students? How do you know?"
- "Why do you think most students chose this gift?"
- "Which gifts were the second and third most popular? How do you know?"
- "Which gift was chosen least often? Why do you think that most students did not choose this gift?"
- "What would you recommend to the managers of the Party Pack Company?"

Post all the graphs. Ask students to examine and discuss the various graphs. Ask:

- "How are the graphs alike? How are they different?"
- "Which graphs are easy to understand? Why are they easy to understand?"
- "Which parts of the graph help you to understand the information that is presented?"
- "Are there any graphs that have important parts missing? What needs to be added?"
- "How could the managers of the Party Pack Company use these graphs?"
- "What other kinds of graphs could be used to present the information about the favourite gift items? What would the graphs look like?"

ADAPTATIONS/EXTENSIONS

Some students may require guidance in conducting a survey, organizing survey results, and creating graphs. Have these students work with classmates who can explain processes for collecting and organizing data and who will support them in participating in group activities.

Extend the activity by having students examine all graphs prepared by different groups. Ask the following questions:

- "According to all the graphs, what *kinds* of gift items were chosen most often (e.g., toys, decorations, writing materials)?"
- "Why do you think students chose these kinds of gifts?"
- "What advice would you give to the managers of the Party Pack Company about the kinds of gift items that most children like?"

Have students write letters to the managers in which they give their advice about the general kinds of gift items (e.g., toys, puzzles, craft materials) that will be popular with children.

MATH LANGUAGE

- data
- survey
- tally
- many, more, most
- few, fewer, fewest
- less, least
- graph

ASSESSMENT

Observe students as they conduct surveys, organize data, and create graphs, and assess how well they:

- gather data using a survey;
- organize data (e.g., record data using a tally);
- display collected data in a graph;
- create graphs that clearly present information (e.g., using appropriate titles, labels, symbols);
- describe data presented in graphs.

HOME CONNECTION

Send home CO2.BLM3: Survey Questions. This Home Connections activity provides an opportunity for students to discuss how survey questions can be used to gather information.

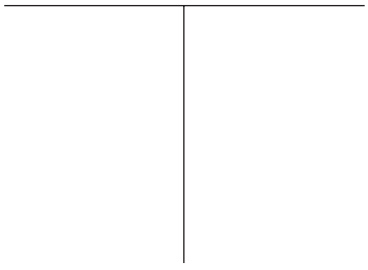
LEARNING CONNECTION 1

Using KidPix to Create T-Charts

Materials

- KidPix (Ministry-licensed software)
- computer(s)

Have students create T-charts using KidPix. To begin, instruct students to use the line tool to create a chart.



Next, ask students to label the columns "Living" and "Non-living" using the alphabet stamps.

Have students look at the various KidPix picture stamps. Ask them to decide whether each picture shows a living or non-living thing, and to stamp the picture in the appropriate column of the T-chart. Provide time for students to stamp several pictures in their charts.

Have students examine their T-charts (on computer screens or hard copies). Ask students to explain how they organized the pictures in the charts.

Invite students to create other T-charts using KidPix. Have them decide how they might classify pictures into two categories.

LEARNING CONNECTION 2

Better Questions

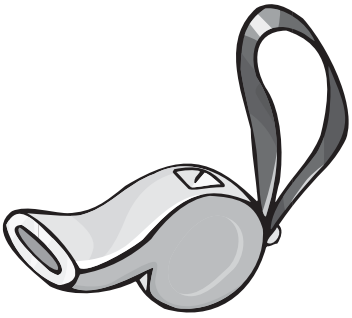
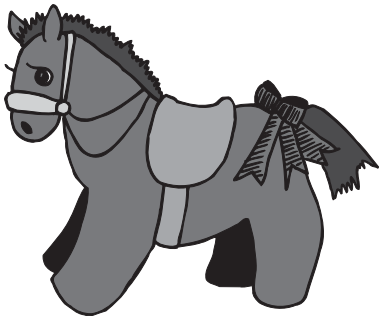
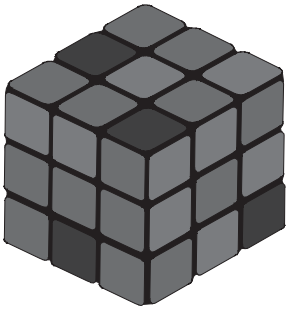
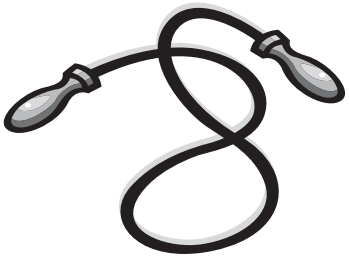
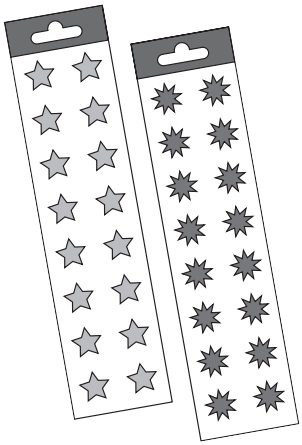
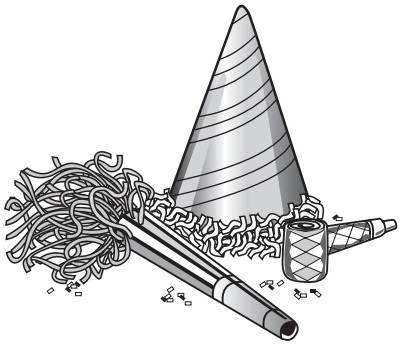
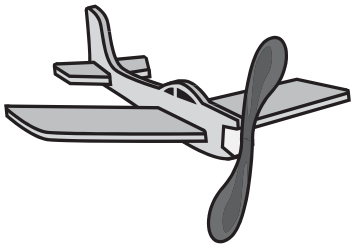
Ask students to raise their hand when their answer is "yes" to the following questions:

- "Is summer your favourite season?"
- "Is chocolate your favourite flavour of ice cream?"
- "Do you have a pet cat?"
- "Did you play a game at recess?"

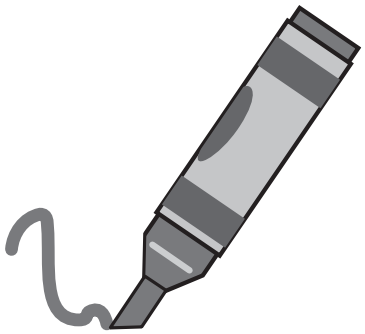
Discuss how the questions do not provide any information about the favourite seasons (favourite flavours of ice cream, pets, recess activities) of students who did not raise their hands. Ask: "What would be a better question to ask if I wanted to know everyone's favourite season?" Discuss how a question such as "What is your favourite season?" allows everyone to respond.

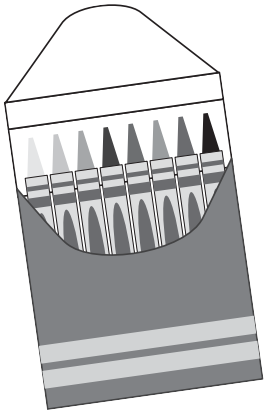
Discuss questions that would allow all students to give an answer concerning their favourite flavours of ice cream, favourite pets, and favourite recess activities.

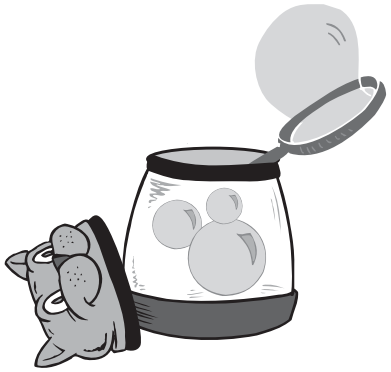
Gift Items

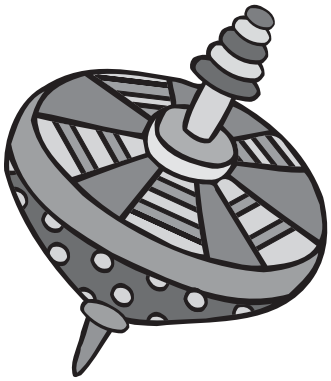
		
		
		

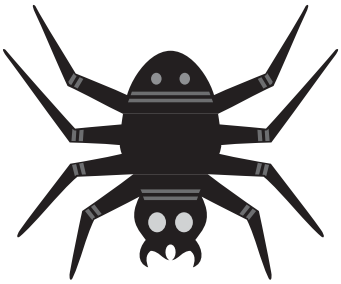
Gift Items

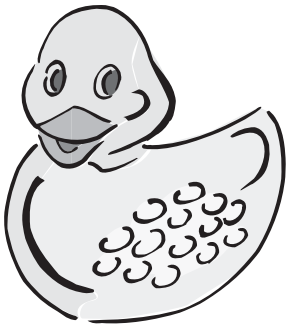


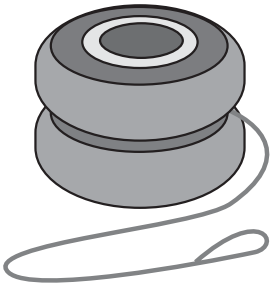


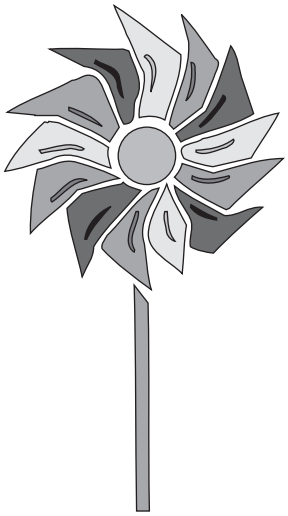








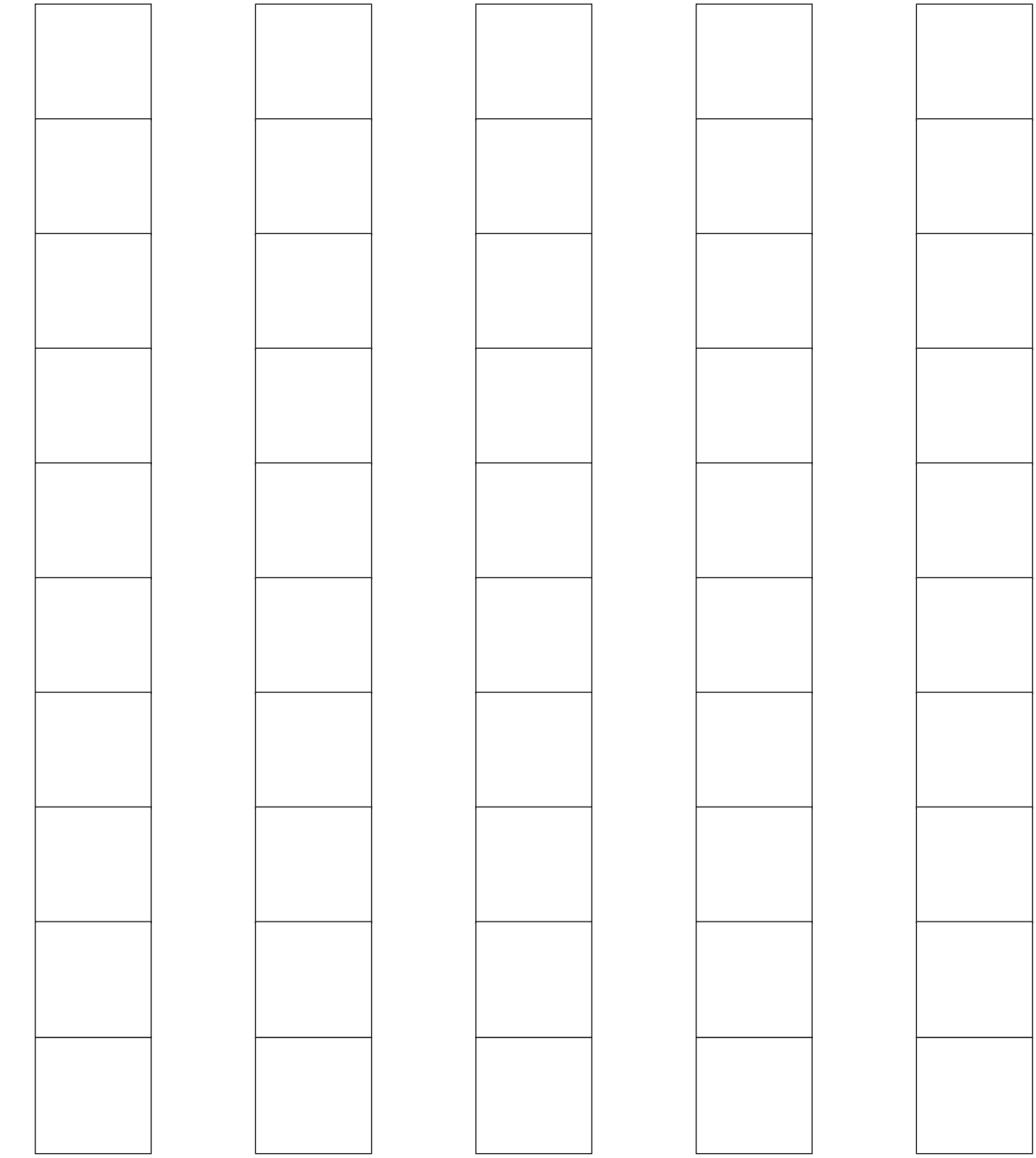




Graph Template

CO2.BLM2

Title: _____



_____ _____ _____ _____ _____

Survey Questions

Dear Parent/Guardian:

Our class has been learning about surveys. We have worked together to develop survey questions and to ask classmates these questions in order to gather information. Ask your child to tell you about the survey he or she conducted in class.

Here is an opportunity for you to talk more about survey questions with your child. Read the following situations together, and then discuss a survey question that would provide the needed information. Have your child record the survey question.

A teacher is planning a party for the class. The teacher would like students to play a favourite game. What survey question could the teacher ask students?

_____

The park committee would like to build some play equipment in the park. They want to build equipment that children will enjoy. What survey question could the committee ask children?

_____

The manager of a grocery store would like to sell fruits that customers will buy. What survey question could the manager ask customers?

_____

What Is the Graph About?

BIG IDEA **Data Relationships**

CURRICULUM EXPECTATIONS

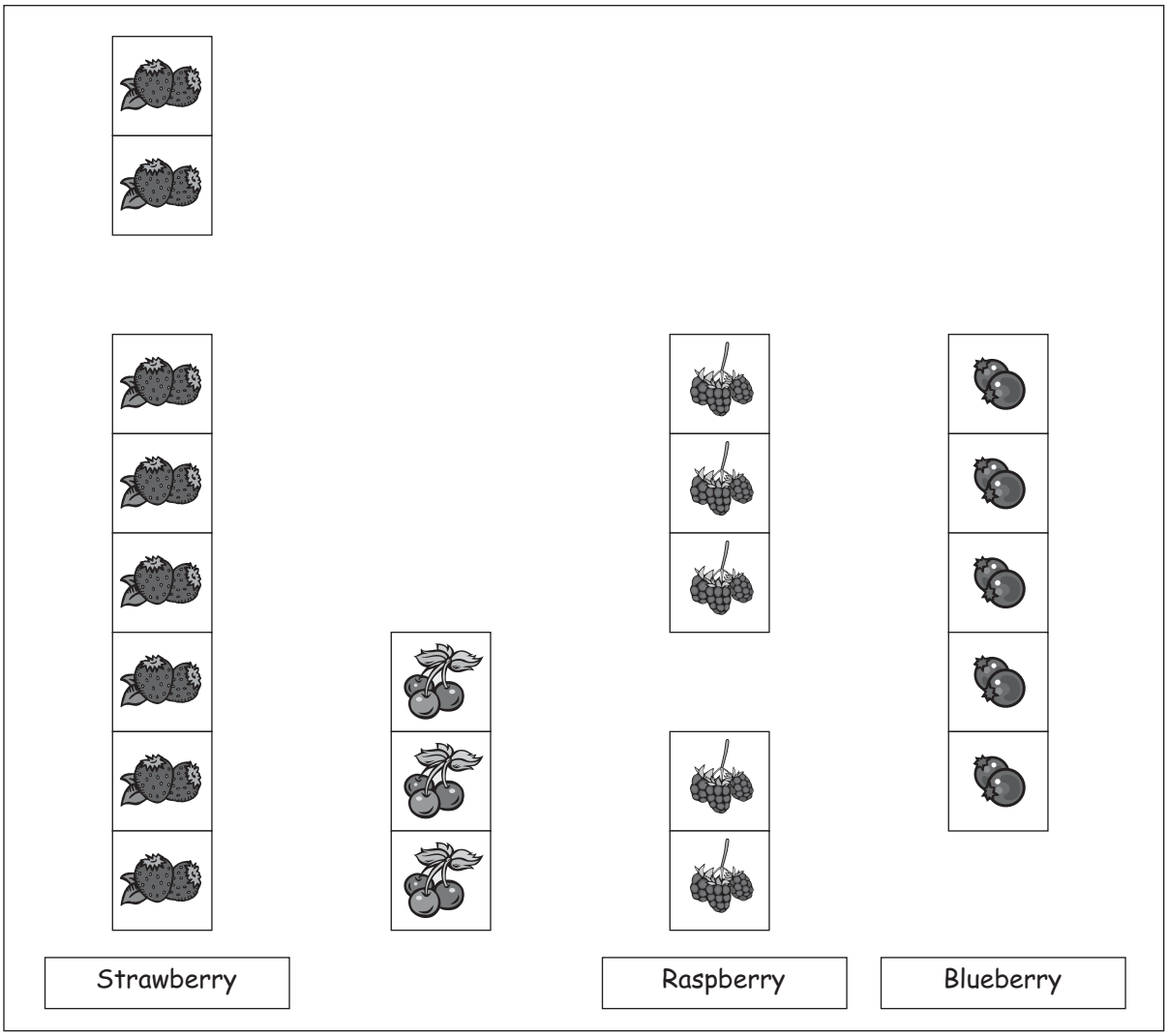
Students will:

- read primary data presented in concrete graphs, pictographs, line plots, simple bar graphs, and other graphic organizers (e.g., tally charts, diagrams), and describe the data using mathematical language (e.g., "Our bar graph shows that 4 more students walk to school than take the bus.");
- pose and answer questions about class-generated data in concrete graphs, pictographs, line plots, simple bar graphs, and tally charts (e.g., Which is the least favourite season?);
- demonstrate an understanding of data displayed in a graph (e.g., by telling a story, by drawing a picture), by comparing different parts of the data and by making statements about the data as a whole (e.g., "I looked at the graph that shows how many students were absent each month. More students were away in January than in September.").

MATERIALS

- large envelope
- teacher-made pictograph on chart paper (See diagram on next page. DR1.BLM1: Berries for Pictograph provides picture symbols for the graph.)
- pencils
- crayons
- half sheets of chart paper or large sheets of newsprint (1 per pair of students)
- pieces of paper with title for teacher-made pictograph: "Our Favourite Treat on a 'Berry' Special Day," missing label ("Cherry"), and missing picture symbols
- glue or stick tack
- DR2.BLM2: What Our Graph Tells Us
- DR2.BLM3: Graph Template (if required by students)
- DR2.BLM4: Missing Titles (1 per student)

Diagram of Pictograph



Note that the title, the "Cherry" label, and three picture symbols are added to the graph later in the activity.

ABOUT THE MATH

In the primary grades, students collect data that can be organized into categories, and display the data in concrete graph, pictographs, line plots, and bar graphs. Students learn that the parts of a graph, such as the title, labels, and symbols, help to present the information clearly. They also learn that graphs can be interpreted by comparing the data in different categories of the graph.

In this activity, students solve a problem in which they examine a pictograph without a title. Students speculate what the graph might be about by examining the labels and picture symbols on the graph.

GETTING STARTED

Show students a large envelope containing a pictograph on chart paper. (See the diagram of the pictograph on the previous page.) Introduce the activity by explaining the following:

> "My friend is a teacher at another school. He said that his class has been making some very good graphs. He decided to send us a graph that his class created. In a moment, I will take the graph out of the envelope so that we can look at it. But first of all, I would like to ask you: What would the graph in the envelope need to have to be a very good graph?"

Have students explain characteristics of a good graph. For example, they might suggest that a good graph is completed neatly, has a title and labels, and displays information clearly.

Take the graph out of the envelope and post it where students can view it.

WORKING ON IT

Ask students to describe what they see on the graph. Then ask them to explain whether or not they think the graph is a very good graph. Students might suggest that the graph is not a good example because its purpose is unclear (i.e., it is difficult to determine what the graph is about), and parts of the graph (title, labels, pictures) are missing.

Suggest that the class might be able to determine what the graph is about. Ask:

- "What kind of graph is this?"
- "What do you think the graph is about?"
- "What do you think the title of the graph might be?"
- "What should be added to the graph to make it clearer?"

Discuss various possible interpretations for the graph (e.g., favourite fruits, favourite ice-cream flavours, favourite kinds of pie).

Arrange students in pairs. Provide each pair with pencils, crayons, and a half sheet of chart paper or a large sheet of newsprint. Explain that students are to copy the information from the big graph onto their paper, and that they should add parts to their graph in order to clarify what the graph is about. Explain that when everyone has finished, the class will meet again to talk about what students think the graph is meant to show. Provide guidance to students as they create their graphs. Provide students who need help in organizing the graph with a copy of DR2.BLM3: Graph Template.

REFLECTING AND CONNECTING

Gather students and have some pairs present their completed graphs to the class. Discuss what each pair added to the graph in order to show what it is about. After each presentation, ask:

- "Do you think this is a possible meaning for the graph? Why or why not?"
- "Does the graph make sense?"
- "What other parts should be added so that the graph is clear?"
- "If this is what the graph is about, what does the graph tell us?"

Discuss how the interpretation of the graph changes according to the title given to the graph. For example, the column with the most picture symbols might show that most students choose "strawberry" as their favourite fruit, as their favourite ice-cream flavour, or as their favourite kind of pie.

Tell students about an important discovery:

> "While you were working on your graphs, I looked into the envelope. Can you guess what I found? In the bottom of the envelope, I found parts of the graph that had come unglued from the graph! Perhaps we should look at these parts of the graph to help us know what the graph is really about."

Take a piece of paper with the title "Our Favourite Treat on a 'Berry' Special Day" out of the envelope. Show the paper, and ask students to explain what part of the graph it represents. Discuss how the title provides information about what the graph is about. Attach the title to the graph on chart paper.

Clarify the significance of the title:

> "I think I know when my friend's class made this graph. One day the class had a 'Berry' Special Day. My friend brought different kinds of berries to school for a treat. Then students made a graph to show which berries they like best."

Ask: "Do you think that there are other parts of the graph in the envelope? What could they be?"

Show students the other parts of the graph (i.e., label, pictures), and discuss how they are important components of the graph. Attach the label and pictures to the graph.

Tell students that the envelope also contains a sheet of paper entitled "What Our Graph Tells Us". Before showing DR2.BLM2: What Our Graph Tells Us, have students predict the information that is recorded, asking them to explain their observations, for example, by saying, "Most students chose strawberry as their favourite treat," "Fewest students chose cherry," "The same number of students chose raspberry and blueberry," "Six more

students chose strawberry than chose cherry." Show students DR2.BLM2: What Our Graph Tells Us, and read the information together.

Conclude the activity by asking the following questions:

- "Why is it important to include a title on a graph?"
- "What other parts of a graph are important? Why are they important?"
- "What are other characteristics of a good graph?"

ADAPTATIONS/EXTENSIONS

Some students may have difficulty creating a smaller version of the graph on chart paper. Pair these students with a classmate who can assist in organizing the small graph and in transferring information from the large graph. Consider providing DR2.BLM3: Graph Template for students who have difficulties creating a small graph on their own.

Extend the activity by having students conduct a survey with their classmates about favourite kinds of berries (or fruits). Have students create a graph (e.g., pictograph, bar graph) to present the data. Ask students to compare their findings with those presented in the graph on chart paper used in the activity.

MATH LANGUAGE

- pictograph
- picture symbol
- data
- title
- label

ASSESSMENT

Observe students to assess how well they:

- explain the different parts of a pictograph (e.g., title, label, picture symbol) and how they help to present information in the graph;
- suggest an appropriate title for a graph;
- create a graph with its necessary parts (e.g., title, label, pictures);
- describe data presented in graphs (e.g., compare data, draw conclusions from data).

HOME CONNECTION

Send home DR2.BLM4: Missing Titles. In this Home Connection activity, parents and students examine pictographs and bar graphs, and surmise what the graphs are about.

In class, have students explain how they and their parents interpreted the graphs.

LEARNING CONNECTION 1

True or False

Materials

- overhead transparency of DR2.BLM5: How We Get to School
- overhead projector

Display an overhead transparency of DR2.BLM5: How We Get to School. Discuss the graph by asking:

- "What is the title of the graph?"
- "What kind of graph is it?"
- "What do you think the survey question might have been?"
- "What were the possible answers to the survey question?"
- "What do the picture symbols mean?"

Next, make true and false statements about information presented in the graph. Have students show a thumbs-up gesture if they agree with the statement, and a thumbs-down gesture if they disagree. Include statements such as:

- "Most students walk to school."
- "Most students arrive by bus."
- "More students arrive by bus than walk."
- "Fewer students walk than arrive by car."
- "The same number of students walk as arrive by car."
- "The graph shows that some students arrive by helicopter."
- "Four more students arrive by bus than arrive by car."
- "Fewer than fifteen students answered the survey question."

Whenever students disagree with a statement, ask them to explain why they disagree.

LEARNING CONNECTION 2

Pencil Glyphs

Materials

- DR2.BLM6: Pencil Glyph (1 per student)
- DR2.BLM7: Pencil Glyph Legend (1 per student)
- crayons

A glyph is picture or diagram in which symbols and/or colours represent certain kinds of information.

Provide each student with DR2.BLM6: Pencil Glyph, DR2.BLM7: Pencil Glyph Legend, and crayons. Instruct them to colour their personal pencil glyphs according to the legend on DR2.BLM7: Pencil Glyph Legend.

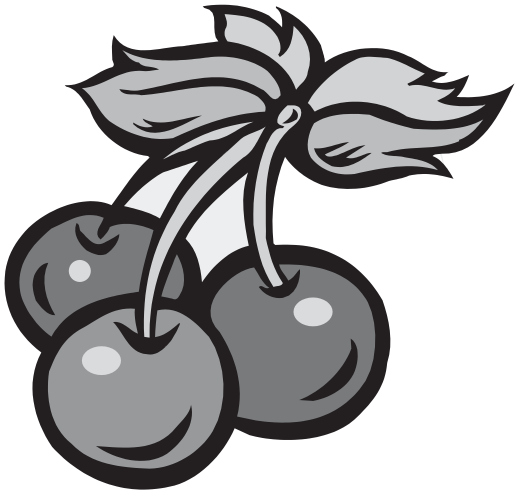
Post the completed glyphs. Ask questions that allow students to observe information presented in the glyphs:

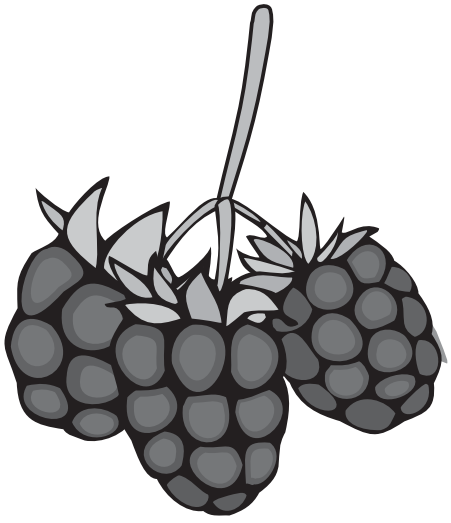
- "How many students made a glyph today?"
- "How many students are boys?"
- "How many students rode the bus to school today?"
- "Are there more oldest or youngest students?"
- "How many students coloured their ruler green? What does that mean?"
- "What other information do you know about our class by reading our glyphs?"

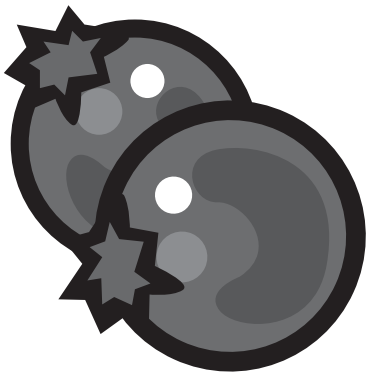
As an extension to this activity, students could create their own glyphs and legends for classmates to complete.

Berries for Pictograph

DR2.BLM1







What Our Graph Tells Us

DR2.BLM2

Most students chose strawberry as their favourite berry treat.

The fewest students chose cherry as their favourite berry treat.

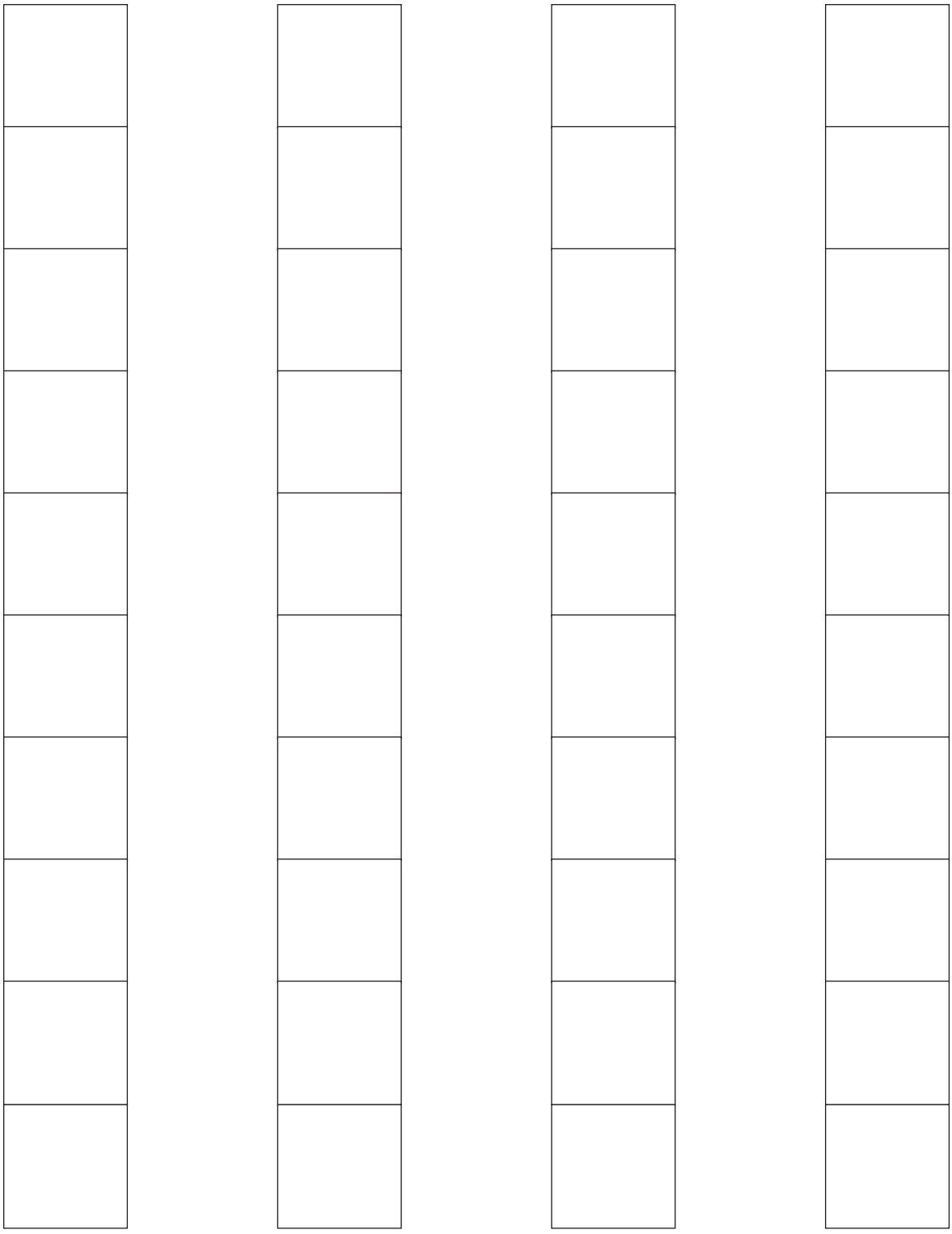
The same number of students chose raspberry and blueberry.

Twenty-four students chose their favourite berry treat.

Six more students chose strawberry than chose cherry.

DR2.BLM3

Graph Template



_____ _____ _____ _____

DR2.BLM4

Missing Titles

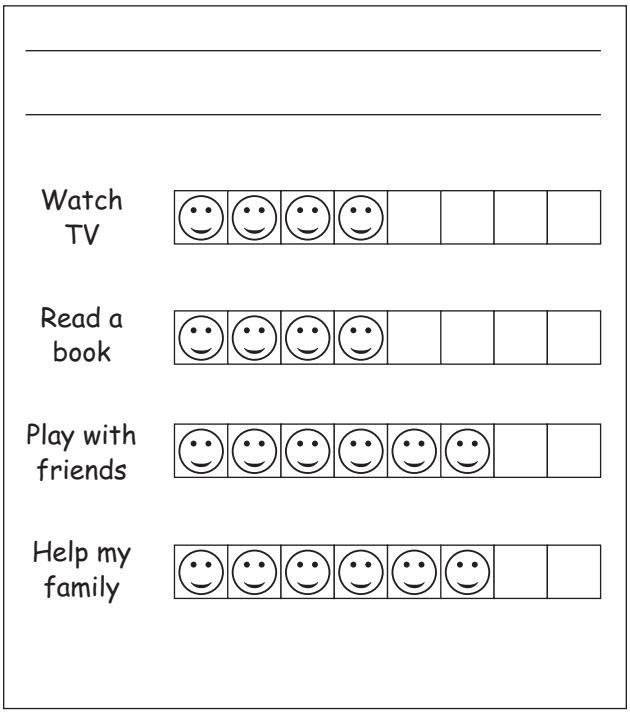
Dear Parent/Guardian:

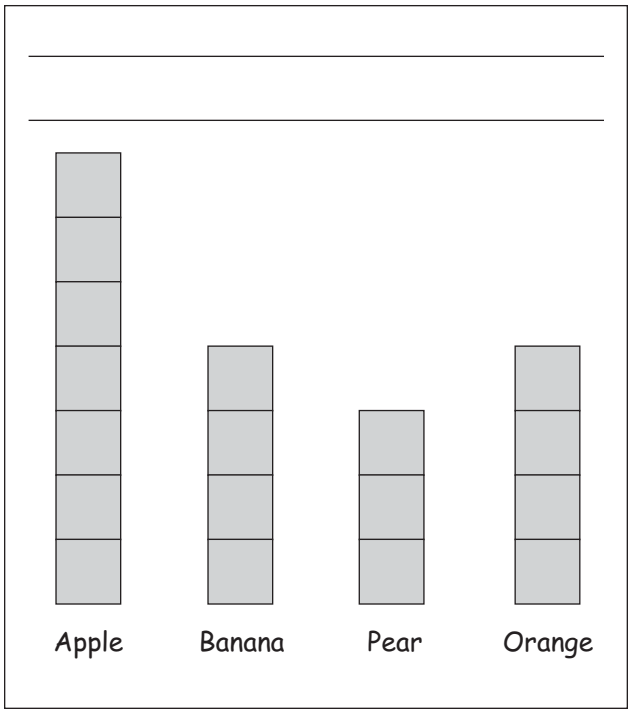
Our class has been learning about graphs. Students discussed how a title is an important part of the graph because it helps people to understand the information presented in the graph.

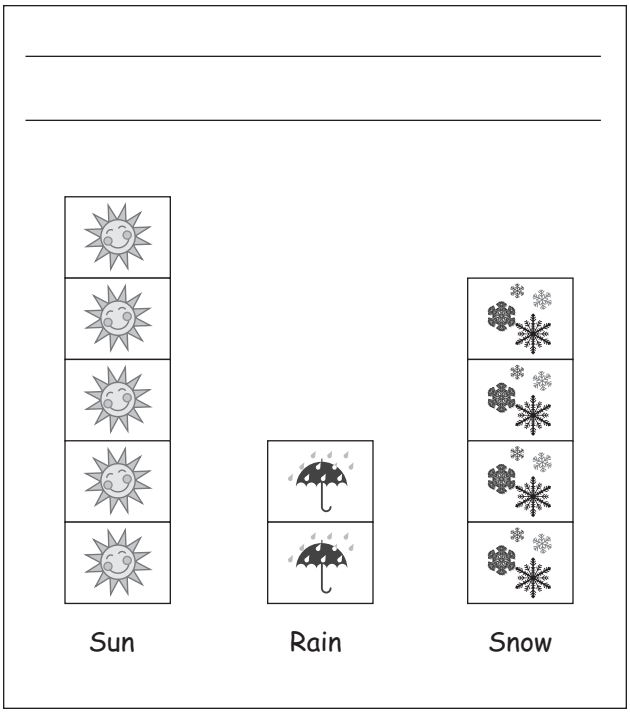
Here is an activity to do with your child. Explain that the title is missing from the three graphs on this page. Discuss what each graph might be about, and ask your child to create a title. Have your child print a title on each graph.

Have your child return this page to school so that we can discuss the different titles the students gave to the graphs.

Thank you!

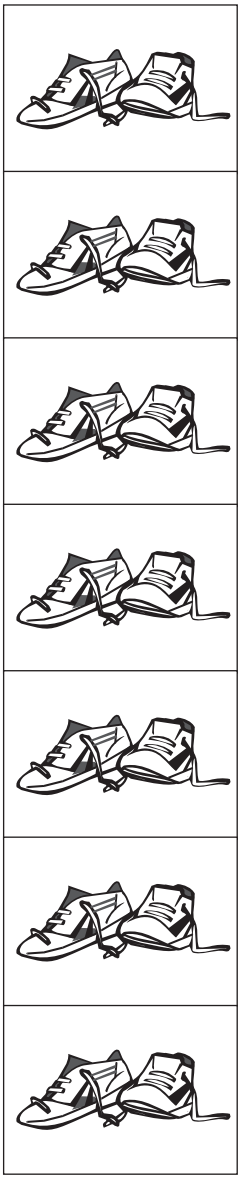




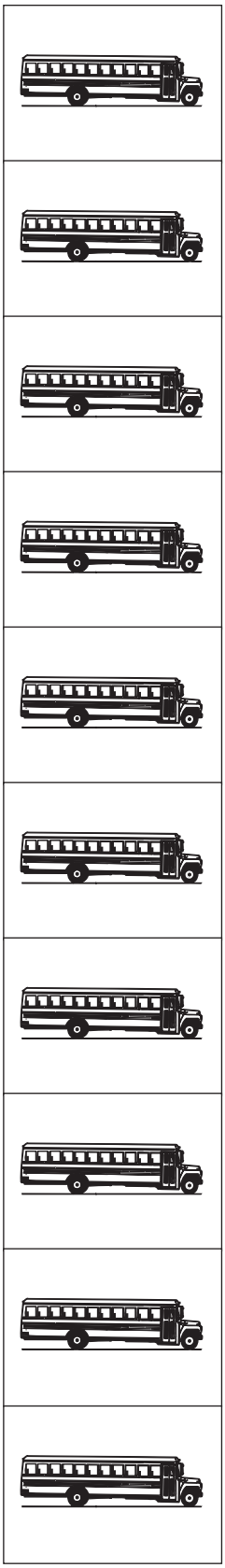


DR2.BLM5

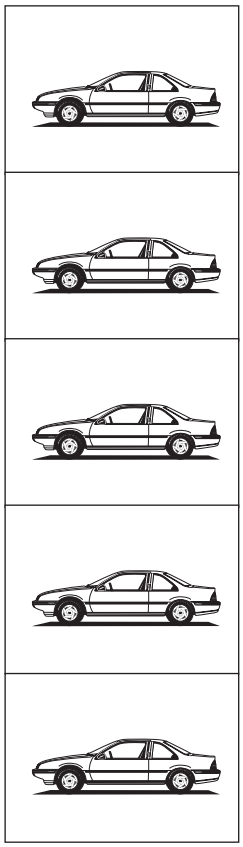
How We Get to School



Walk



Bus



Car

Pencil Glyph

Pencil Glyph Legend

Colour your glyph by following the legend below.

eraser	red – if girl
	blue – if boy
pencil body	yellow – if 5 years old
	orange – if 6 years old
	brown – if 7 years old
	red – if 8 years old
book	purple – if you came to school on a bus
	green – if you walked to school
	orange – if you came to school by car, van, or truck
	blue – if you rode your bike or scooter to school
ruler	red – if you are the only child in your family
	blue – if you are the youngest child in your family
	yellow - if you are a middle child in your family
	green – if you are the oldest child in your family
shoes	black – if you have a pet
	red – if you do not have a pet

Game Testers

BIG IDEA **Probability**

CURRICULUM EXPECTATIONS

Students will:

- describe probability as a measure of the likelihood that an event will occur, using mathematical language (i.e., *impossible*, *unlikely*, *less likely*, *equally likely*, *more likely*, *certain*) (e.g., "If I take a new shoe out of a box without looking, it's equally likely that I will pick the left shoe or the right shoe.");
- describe the probability that an event will occur (e.g., getting heads when tossing a coin, landing on red when spinning a spinner), through investigation with simple games and probability experiments and using mathematical language (e.g., "I tossed 2 coins at the same time, to see how often I would get 2 heads. I found that getting a head and a tail was more likely than getting 2 heads.").

MATERIALS

- Prob2.BLM1: Spin to Win Game Board (1 per pair of students; 1 for each student to take home)
- blue counters and red counters (1 of each per pair of students)
- spinners made with a circle cut from Prob2.BLM2: Spinners, a paper clip, and a pencil (1 spinner per pair of students; 1 for each student to take home)
- chart paper
- sheets of lined paper (1 per student)
- Prob2.BLM3: Who Will Win? (1 per student)

ABOUT THE MATH

Students develop concepts about probability by playing games in which they think about the likelihood of certain events (e.g., the likelihood of a spinner landing on a specific colour). Games that involve various spinners and number cubes (dice) help students to understand that factors other than luck can influence the outcome of a game.

In this activity, students play a game using a variety of spinners on which the size of the red and blue sections varies. The game provides an opportunity for students to think about how the design of a spinner affects the probability of winning the game.

GETTING STARTED

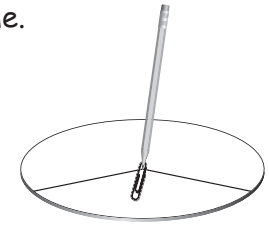
Read the following letter aloud to the class.

> Dear Students:
>
> We are excited about the new Spin to Win game that we are working on at the Toy Company. We need your help in playing the game and telling us what you think about it. Your ideas will help us improve the game.
>
> We hope you enjoy playing the Spin to Win game. We look forward to receiving your feedback.
>
> Sincerely,
> The President of the Toy Company

Show students Prob2.BLM1: Spin to Win Game Board and explain the game:

- Students play the game with a partner.
- Players decide who will use the red counter and who will use the blue counter. They place both counters on START.
- Players take turns spinning a spinner that will be given to them by the teacher. Players move their counter ahead one space according to the colour the spinner lands on.
- The first player to arrive at FINISH wins the game.

Show students how to make a spinner using a spinner circle from Prob2.BLM2: Spinners, a paper clip, and a pencil.



WORKING ON IT

Arrange students in pairs. Provide each pair with a copy of Prob2.BLM1: Spin to Win Game Board, materials for making a spinner, a red counter, and a blue counter. Give one spinner circle from Prob2.BLM2: Spinners to each pair of students.

Provide time for students to play the game.

After students have played the game, explain that the president of the Toy Company has provided a list of questions for students to answer about the game. Display the following questions on the board or chart paper:

- Did you like playing the game?
- Did you think the game was fair? Why or why not?

- Do you think other children will enjoy playing this game? Why or why not?
- What changes would you make to the game?

Explain to students that they will write a letter in which they provide feedback on the game to the company president. Tell students that the president would like answers to all of the questions that are listed on the board or chart paper. Provide each student with a sheet of lined paper for his or her letter.

REFLECTING AND CONNECTING

Ask pairs of students to share their experiences in trying out the game. Ask questions, such as the following:

- "Was the game fair? Why or why not?"
- "Was it likely or unlikely that the spinner would land on red? on blue?"
- "Which player would more likely win with this spinner?"
- "How would you change the game so that players have an equal chance of winning?"

Compare the different spinners, and discuss which player would likely win the game with each type of spinner. Ask pairs who used the same type of spinner to compare their results, and discuss any similarities or differences in their findings about the game.

Have students read aloud their letters to the Toy Company president.

ADAPTATIONS/EXTENSIONS

Some students may need to play the game more than once, and with different spinners, to help them recognize that the likelihood of winning depends on the way the spinner is divided into sections. Students might also have difficulty writing the feedback letter to the company president. Ask these students to write a brief note in which they explain whether they think the game is fair or not. Consider whether some students should explain their ideas orally rather than in written form.

Extend the game by having students make different spinners that allow the following outcomes for the player who has chosen red:

- somewhat likely to win
- very likely to win
- somewhat unlikely to win
- very unlikely to win

MATH LANGUAGE

- fair
- unfair
- likely
- unlikely
- chance
- never
- sometimes
- always

ASSESSMENT

Observe students to assess how well they:

- explain the likelihood that an event will occur (e.g., the likelihood that "red" will win the game);
- explain the relationship between the spinner and the likely outcome of the game (e.g., "blue" will likely win because most of the spinner is blue);
- describe probability using appropriate language (e.g., impossible, likely, unlikely, equally likely, good/poor chance).

Read students' letters to assess their understanding of probability and their communication of ideas related to probability.

HOME CONNECTION

Prob2.BLM3: Who Will Win? provides a Home Connection activity in which students and parents play the Spin to Win game using different spinners. Students examine the spinner used in each game and predict the winner.

Along with Prob2.BLM3: Who Will Win? students need to take home a copy of Prob2.BLM1: Spin to Win Game Board and Prob2.BLM2: Spinners. Provide paper clips (for spinners) to students who may not have them at home.

LEARNING CONNECTION 1

Find the Right Bag

Materials

- four paper bags, labelled "Bag A", "Bag B", "Bag C", and "Bag D". The contents of the bags are as follows:
  Bag A: 10 green cubes, 5 blue cubes, 5 red cubes
  Bag B: 5 blue cubes, 15 red cubes
  Bag C: 10 blue cubes, 10 red cubes
  Bag D: 15 blue cubes, 5 red cubes
  (Use colour tiles or slips of colour paper if you have insufficient numbers of colour cubes.)

Show the paper bags to the class and explain that each bag contains 20 cubes. Tell students that their challenge is to figure out which bag contains exactly 10 blue cubes and 10 red cubes.

Place the bags in a row in front of the class. Have students, one at a time, call out "Bag A", "Bag B", "Bag C", or "Bag D". After students select a bag, remove a cube from that bag, and place it in front of the bag so that students can observe its colour.

After all students have had a turn to select a bag, ask the following questions:

- "Which bag, do you think, has 10 blue cubes and 10 red cubes? Why?"
- "Is it likely that there are 10 blue cubes and 10 red cubes in Bag A? Bag B? Bag C? Bag D? Why is it likely? unlikely? impossible?"
- "Which bag is more likely to be the correct bag: Bag C or Bag D?"

Reveal the contents of the bags and discuss the accuracy of students' predictions.

Play a variation of the game. After each student calls out the letter of a bag, draw a cube from the bag, show the colour to students, and return the cube to the bag. After all students have selected a bag, discuss the likelihood of each bag containing 10 blue cubes and 10 red cubes.

LEARNING CONNECTION 2

Colour Cubes Under Cups

Materials

- polystyrene or paper cups (3 per pair of students)
- colour cubes (or colour tiles; 6 to 10 per pair of students)
- sheets of paper
- pencils

Have students work with a partner. Provide each pair of students with three polystyrene or paper cups and six to ten colour cubes. Explain the activity:

- Student A places a colour cube under each inverted cup while Student B looks away. Student A arranges the cups in a row in front of Student B.
- Student B looks under one cup, observes the colour of the cube, and replaces the cup over the cube. Student B may record the colour on a sheet of paper.
- Student A shuffles the cups quickly in order to rearrange them (and confuse Student B about which cup he or she just selected).
- Student B chooses a cup again, observes the colour of the cube, and records the colour.

- Student B has five chances to look at the cube under a cup. Student A reshuffles the cups each time after Student B looks under a cup.
- After looking under cups five times, Student B tells Student A the colours of cubes that are likely under the cups.
- Students look under the cups to check the student's prediction.

Provide time for students to play the game several times, having them change roles after each game. Ask questions that encourage students to think about and discuss the likelihood of certain colour cubes under the cups:

- "What colour of cubes are likely under the cups? Why do you think that?"
- "Is it possible that there is more than one red cube? Why or why not?"
- "Can you be certain about the colours of cubes under the cups? Why or why not?"

You might challenge students to play a more difficult version of the game in which colour cubes are placed under five cups. Students have eight chances to look under cups before predicting the colours of cubes.

LEARNING CONNECTION 3

Probability Continuum

Materials

- string or cord (approximately 2 to 3 metres long)
- 1 card with "Certain" printed on in and 1 card with "Impossible" printed on it
- cards cut from Prob2.BLM4: Event Cards
- clothespins

Suspend a string (or cord) in the classroom. Attach a card labelled "Impossible" to the left end of the string, and a card labelled "Certain" to the right end of the string. Show cards cut from Prob2.BLM4: Event Cards to the class, and explain that students will need to decide where to pin the event cards to the line. Ask:

- "What kinds of events will we pin close to the 'Impossible' card?"
- "What kinds of events will we pin close to the 'Certain' card?"
- "What kinds of events will we pin close to the middle of the string?"

Read aloud the event cards. After reading each card, have students point to the place on the string where they think the card should be attached. Ask questions that encourage students to use language to describe the likelihood of events (e.g., likely, unlikely, equally likely, almost certain, impossible):

- "Why do you think this event should be attached here?"

- "Why should this event be attached close to the 'Certain' card?"
- "Is this event more likely than this other event? Why or why not?"
- "Should this card be attached to the right or to the left of this other card? Why?"

Use clothespins to attach the event cards to the string according to students' decisions.

After all cards have been attached to the string, ask: "Are all the cards in their correct spot on the string?" Have students justify any changes they would like to make.

LEARNING CONNECTION 4

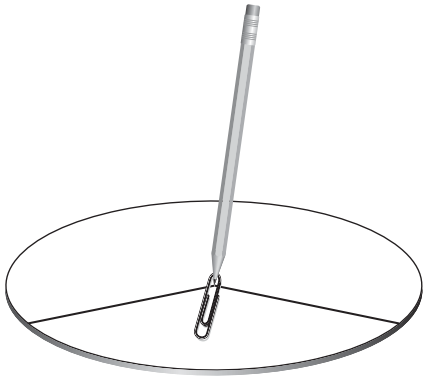
Creating Spinners

Materials

- Prob2.BLM5: Creating Spinners (1 per student)
- pencils
- rulers
- crayons
- paper clips (1 per student)

Provide each student with a copy of Prob2.BLM5: Creating Spinners. Tell students that they need to divide the spinner circles into coloured sections according to the clues provided for each circle. Provide pencils, rulers, and crayons for students to create the spinners.

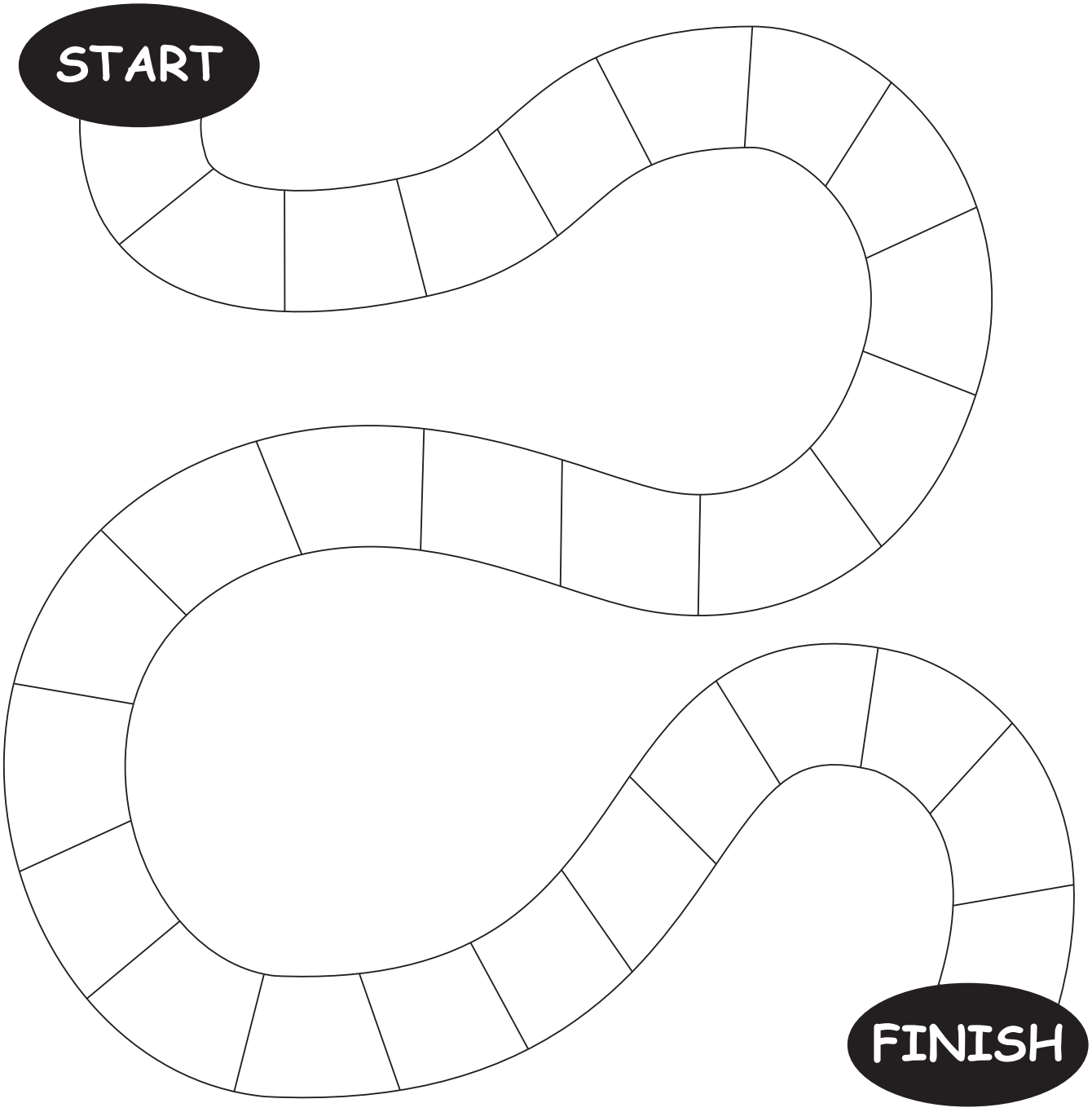
Show students how to make a spinner using the spinner circles on Prob2.BLM5: Creating Spinners, a paper clip, and a pencil.



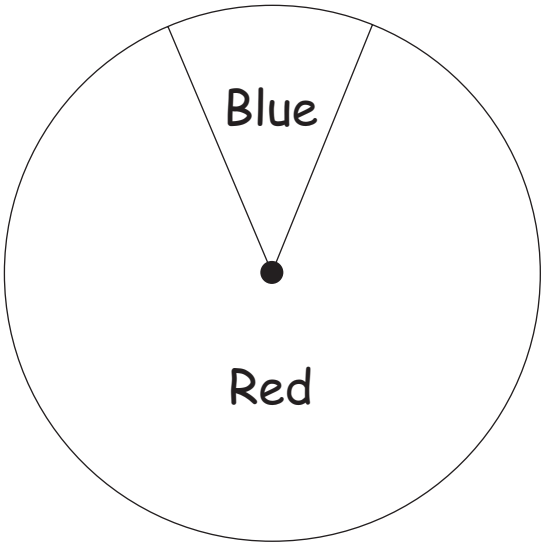
Arrange students in pairs. Give each pair a pencil and a paper clip, and have them test the spinners that both students created. Instruct students to spin each spinner 20 times, and to keep a tally of the colours shown on each spin. Have pairs determine whether the results matched the clues given for each spinner.

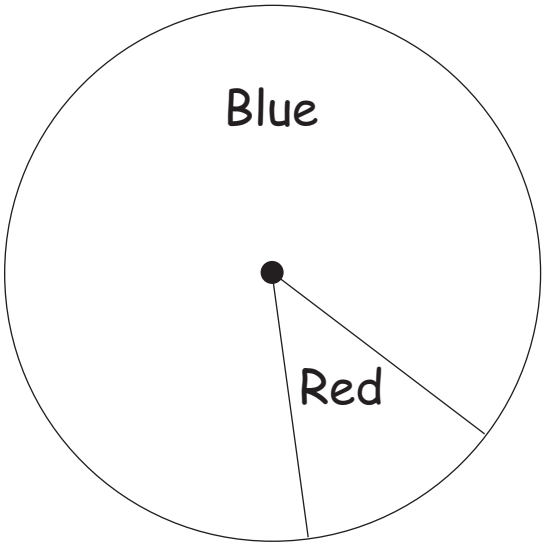
Spin to Win Game Board

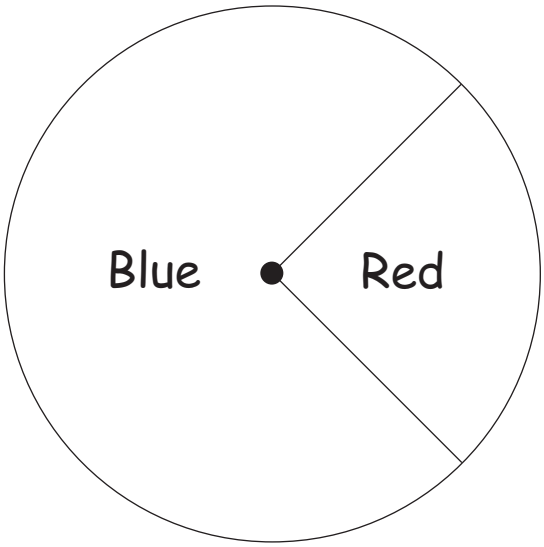
Prob2.BLM1

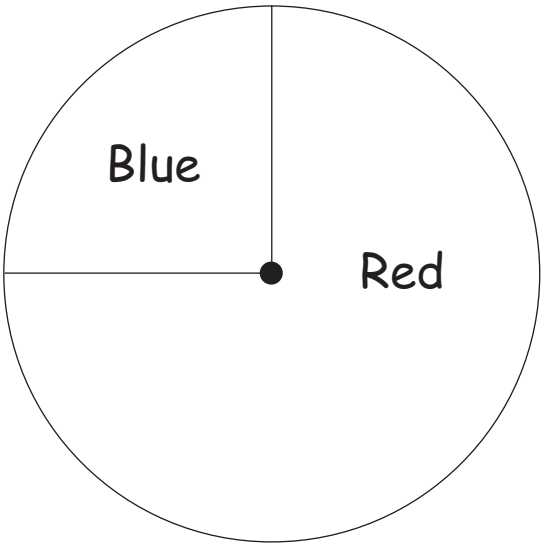


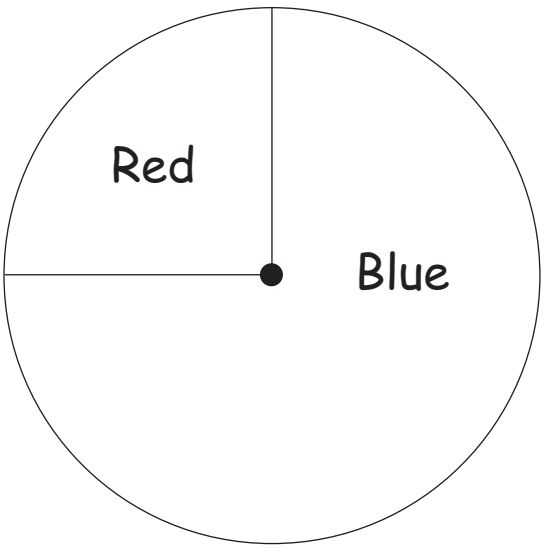
Spinners

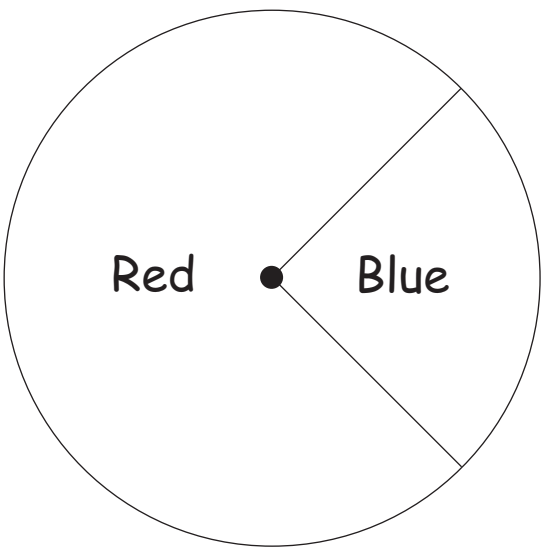












Who Will Win?

Dear Parent/Guardian:

We have been learning about probability in math class. You can help your child review ideas about probability by playing the Spin to Win game.

To play the game, you will need the game board and spinners (on the attached pages), a red and a blue button (or any two small objects that can be used as game pieces), a paper clip, and a pencil.

Here is how to play the game:

- Players decide who will use the red button and who will use the blue button, and place both buttons on START.
- Together, players choose one of the spinners on the attached page. Each player predicts who will win the game.
- Players take turns spinning the spinner. Players move their counter ahead one space according to the colour the spinner lands on.
- The first player to arrive at FINISH wins the game.

After playing the game, ask your child these questions:

- Why did you predict red (or blue) would win?
- Was your prediction correct?
- Why do you think your prediction was (or was not) correct?
- Would you change your prediction if we played the game again using the same spinner? Why or why not?

Play the game several times with your child. Each time, choose a different spinner. Have your child predict who will win each game.

Thank you for reviewing ideas about probability with your child.

Event Cards

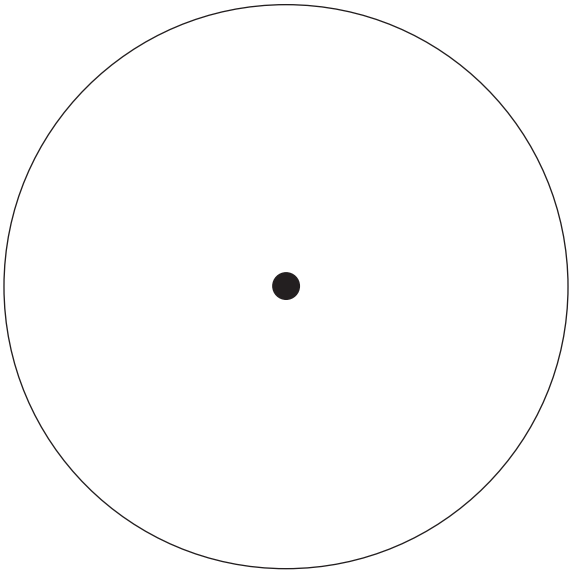
We will have recess.	We will eat lunch.
Most students will be absent tomorrow.	We will play a game.
We will have an indoor recess.	A funny thing will happen this afternoon.
We will have a visitor.	A monkey will be in our classroom.
Everyone will sneeze at the same time.	Someone will get the hiccups.
We will go home after school.	We will sing "O Canada" tomorrow.

Creating Spinners

Spinner A

Red is likely to win.

Green is unlikely to win.

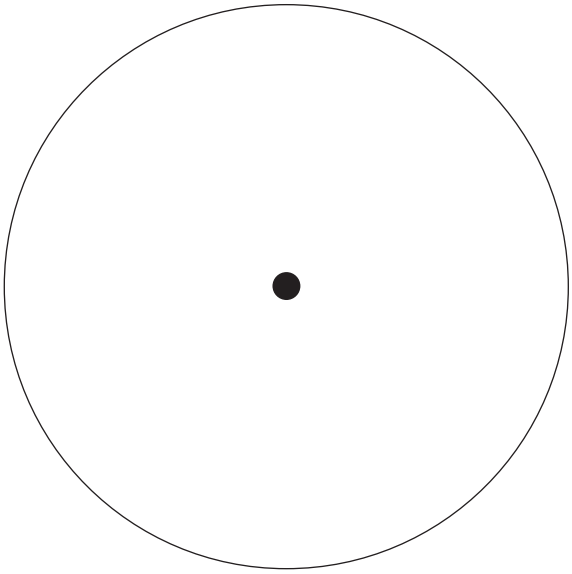


Spinner B

Green is likely to win.

Red is unlikely to win.

Yellow is unlikely to win

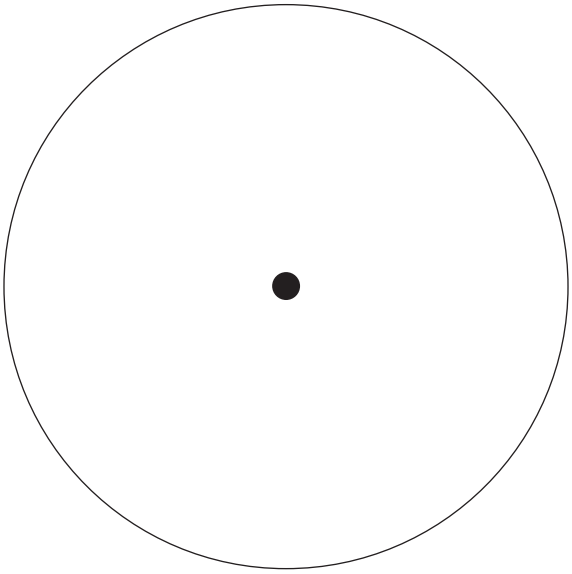


Spinner C

Red likely to win.

Green is more likely to win than red is.

Yellow is very unlikely to win.

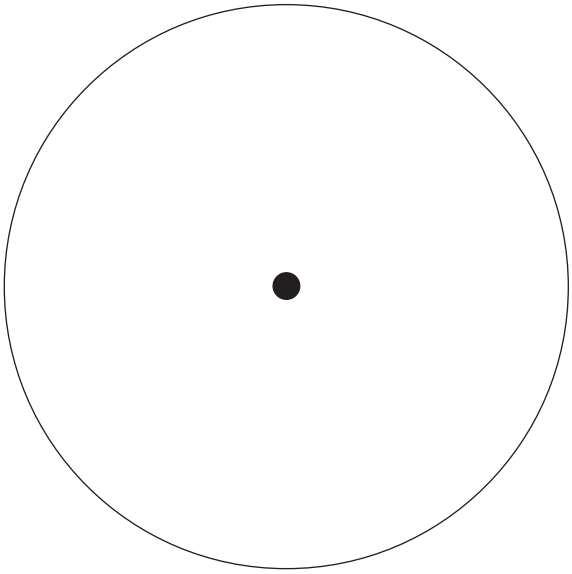


Spinner D

Red and green are equally likely to win.

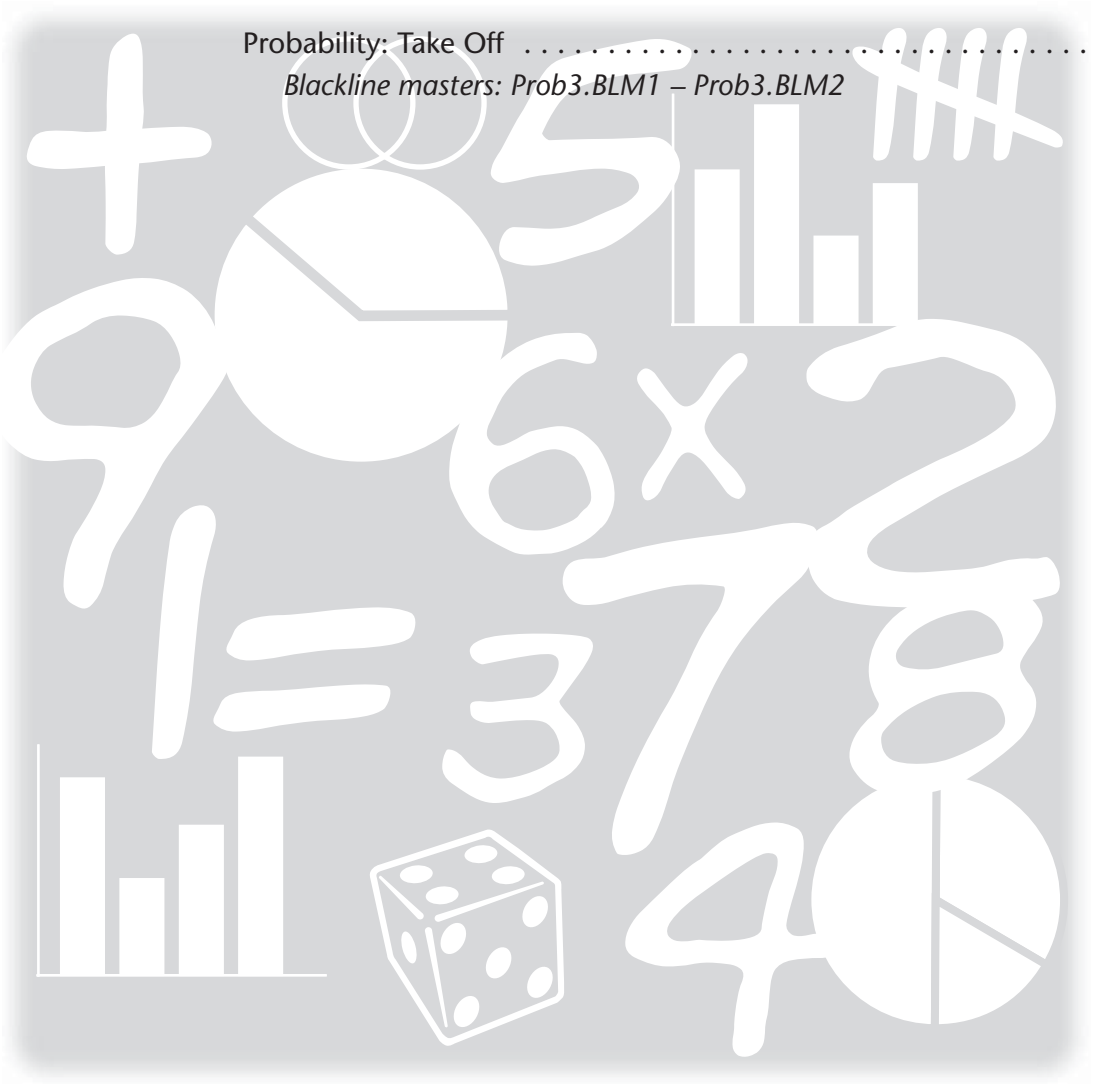
Yellow is unlikely to win.

Blue is less likely to win than yellow is.



D. Grade 3 Learning Activities

Appendix Contents



Lost and Found

BIG IDEA ***Collection and Organization of Data***

CURRICULUM EXPECTATIONS

Students will:

- collect and organize categorical or discrete primary data and display the data in charts, tables, and graphs (including vertical and horizontal bar graphs), with appropriate titles and with labels ordered appropriately along horizontal axes, as needed, using many-to-one correspondence (e.g., in a pictograph, one car sticker represents 3 cars; on a bar graph, one square represents 2 students).

MATERIALS

- CO3.BLM1: Record of Lost Items (1 per group of 3 students)
- half sheets of chart paper or a large sheet of newsprint (1 per group of 3 students)
- writing materials (paper, pencils, markers, crayons, rulers) for each group of 3 students
- CO3.BLM2: Discussing the "Lost and Found" Activity (1 per student)

ABOUT THE MATH

Experiences in collecting and organizing data help students to understand that data often need to be arranged into categories in order to interpret data and reach conclusions about what the data show. In the early primary grades, the categories of data are often provided by the teacher or are easily defined by students in a given context. By Grade 3, students should begin to make their own decisions about the categories of data that will provide useful information.

In this activity, students examine a chart of various items in a school's Lost and Found. They need to determine the kinds of items in the chart and categorize them accordingly. Students display the data in a graph and draw conclusions about the kinds of items that are lost most often and least often.

GETTING STARTED

Discuss why a school might have a Lost and Found. Ask:

- "What kinds of things do students lose at school?"
- "What kinds of things would you expect to find in our school's Lost and Found?"
- "What experiences have you had in using a Lost and Found?"

Show students a copy of CO3.BLM1: Record of Lost Items, and explain the following:

"My friend is in charge of keeping a record of lost and found items at another school. Here is a copy of the chart where she has recorded the dates on which lost items have been brought to the Lost and Found, descriptions of lost items, and the names of people who have claimed lost items.

"My friend noticed that there are different categories of lost items. For example, some of the lost items are pieces of clothing, and some are toys. Some of the other lost objects belong to other categories. My friend is wondering if you could help her answer three questions."

Record the following questions on the board:

- What categories of items do student lose?
- What category of items do students lose most often?
- What category of items do students lose least often?

Review the meaning of "category", and have students suggest different categories of lost items (e.g., pieces of clothing, toys, sports equipment). Ask students to suggest ways to find answers to the three questions recorded on the board.

Explain that your friend would like students to prepare a graph that will allow her to compare the numbers of lost items according to the different categories.

WORKING ON IT

Divide students into groups of three. Provide each group with a copy of CO3.BLM1: Record of Lost Items, a half sheet of chart paper or a large sheet of newsprint, and writing materials (paper, pencils, markers, crayons, rulers).

Review the tasks:

- Identify different categories of lost items.
- Collect and organize data to find which category has the greatest number of items, and which category has the fewest number of items.
- Create a graph that allows a person to compare the numbers of lost items in different categories.

Observe students as they work, and provide guidance when needed. Ask questions, such as the following:

- "What categories of lost items have you identified? How did you identify those categories?"
- "What are some items that belong to this category?"

- "Are there items that do not belong to any category? How might you create a special category for these items?"

Although most students will identify similar categories (e.g., clothing, toys, sports equipment, school materials), allow students to classify the materials according to other categories. Students might also find that some items do not fit their categories, and might identify an "Other" category.

Ask questions that help students to think about how they might organize data and create graphs that display the data:

- "How can you organize the data in order to find the category of item that is lost most often? least often?"
- "How might you use a bar graph?"
- "How can you create a graph that allows others to compare the data?"

Encourage students to make their own decisions about the types of graphs they use. It may be necessary to show students how to create and use a specific type of graph (e.g., vertical bar graph, horizontal bar graph).

Note: The number of clothing items listed on CO3.BLM1 is greater than items in other categories. As a result, students creating bar graphs may find that the bar for the Clothing category is relatively tall, if each item of clothing is represented individually on the graph (one-to-one correspondence). Look for opportunities to discuss how many-to-one correspondence might be used in the graph (e.g., each bar segment represents two items).

REFLECTING AND CONNECTING

Review the questions that were recorded on the board during the Getting Started part of the lesson. Ask groups to share how they identified different categories of lost and found items, and determined which category of items were lost most and least often.

Have groups present their graphs. Ask questions, such as the following:

- "What kind of graph did you create? Why did you create this kind of graph?"
- "What parts of the graph help to present information about Lost and Found items?"
- "What does your graph show?"
- "What category of items do students lose most often? Why?"

If any groups used many-to-one correspondence in their graph (e.g., a bar graph in which each segment of a bar represents 2 items), have students explain how they organized the data to indicate the number of items in categories.

Post all the graphs. Ask students to examine and discuss the various graphs. Ask:

- "How are the graphs similar? How are they different?"
- "Which graphs are easy to understand? Why are they easy to understand?"
- "Which parts of the graph help you to understand the information that is presented?"
- "Which graphs have important parts missing? What needs to be added?"
- "Why are the data presented in the graph important to students? their parents? teachers?"
- "What other kinds of graphs could be used to present the information? What would the graph look like?"
- "If you were to do this activity again, would you do anything differently? Why or why not?"

ADAPTATIONS/EXTENSIONS

Some students may require help in identifying categories of lost items, organizing categorical data, and creating graphs. Have these students work with classmates who can explain processes for organizing data and who will support them in participating in group activities.

The activity can be extended in various ways. Students might:

- categorize the lost items according to a less obvious criterion (i.e., according to categories not already identified by groups);
- create different kinds of graphs to display the data, and write a report about which kinds of graphs best present the data;
- write a letter to other students in the school about their findings, and make recommendations to students about ways to prevent losing things.

MATH LANGUAGE

- category, categorize
- tally
- line plot
- bar graph
- data

ASSESSMENT

Observe students to assess how well they:

- identify categories of lost items;
- categorize items according to these categories;
- organize data (e.g., using a tally chart);

- display data in a graph;
- create graphs that clearly present information (e.g., using appropriate titles, labels, scales);
- describe data presented in graphs.

HOME CONNECTION

Send home CO3.BLM2: Discussing the "Lost and Found" Activity. This letter invites parents to discuss the activity with students. It suggests questions parents might ask to encourage students to discuss their findings and recommendations about lost items at school.

LEARNING CONNECTION 1

Classifying Lost Items Using a Venn Diagram

Materials

- CO3.BLM1: Record of Lost Items (1 per pair of students)
- CO3.BLM3: Venn Diagram

Have students work with a partner. Provide pairs of students with CO3.BLM1: Record of Lost Items. Have students circle all items of clothing in the list.

Next, give each pair a copy of CO3.BLM3: Venn Diagram, and have students record the items of clothing in the appropriate sections of the Venn Diagram. Have students explain how they classified the items of clothing in the diagram.

The activity could also involve the classification of all items listed on CO3.BLM1. Students would need to decide which items should be recorded in the area outside the circles (i.e., items that are not clothing).

LEARNING CONNECTION 2

Learning About Our Class

Materials

- Chart paper for teacher
- writing materials, such as pencils, markers, and crayons
- rulers
- sheets of chart paper or large sheets of newsprint (1 per pair of students)

Explain to students that they could learn more about their classmates by conducting a survey. As a class, develop a list of possible survey questions that they could use to gather information about their classmates. Record the questions on chart paper or

the board. Encourage students to develop survey questions that require more than a "yes" or "no" answer (e.g., "What kind of pet do you have?" rather than "Do you have a pet dog?"). Students might generate survey questions such as the following:

- What do you like to do after school?
- What time do you go to bed at night?
- What is your favourite snack?
- How many people are in your family?

After the class has generated a list of several survey questions, arrange student in pairs. Ask each pair to select a survey question.

Provide time for pairs to discuss how they will collect data from classmates. Encourage them to decide:

- how to record responses to the survey question (e.g., using a tally chart, recording responses on sticky notes);
- whether to give classmates possible answer choices (e.g., provide "dog", "cat", "bird", "other", and "no pet" as possible choices to "What kind of pet do you have?"), or allow classmates to give any answer;
- how to keep track of which classmates have and have not answered the survey question.

After pairs have gathered the data for their survey questions, ask them to decide how they might display the data using a chart, graph (e.g., pictographs, bar graphs), or diagram.

Have pairs sketch a rough draft of their chart, graph, or diagram. Next, provide writing materials (pencils, markers, crayons), rulers, and sheets of chart paper or large sheets of newsprint, and have students create a display copy of their chart, graph, or diagram.

Have pairs present their data displays to the class. Encourage them to explain their findings from the survey by referring to the data presented in their chart, graph, or diagram. Invite other students to ask questions about the information gathered through the survey.

Discuss the various methods used by students to collect and organize data, and the different ways in which the data were displayed.

Record of Lost Items

Date	Item	Claimed by
Sept. 12	white sandal	
Sept. 12	green sock	
Sept. 14	light blue sandal	
Sept. 21	pair of black running shoes	
Sept. 26	baseball	K. Brown
Sept. 28	brown baseball glove	J. Sabato
Oct. 4	tennis ball	
Oct. 5	yellow skipping rope	
Oct. 12	red and white stripped sock	
Oct. 20	light brown pencil case	G. Shen
Oct. 25	red sock	
Nov. 1	clown costume	
Nov. 4	red toy truck	P. Gilbert
Nov. 18	book about horses	
Dec. 5	white scarf	H. Finn
Dec. 14	pair of pink mittens	
Jan. 12	red, green, blue scarf	
Jan. 27	pair of black boots	
Feb. 8	yellow tuque	
Feb. 22	hockey stick	
Mar. 3	pair of snow pants	N. Ruzic
Mar. 20	box of markers	
Mar. 27	navy blue T-shirt	
April 5	book of riddles	A. Little
April 12	pair of orange shorts	
April 19	denim jean jacket	
May 3	brown stuffed bear	M. Persa
May 16	pair of white socks	
May 25	red baseball cap	
June 11	light blue T-shirt	D. Chang
June 12	book of fairy tales	
June 20	white skipping rope	

Discussing the "Lost and Found" Activity

Dear Parent/Guardian:

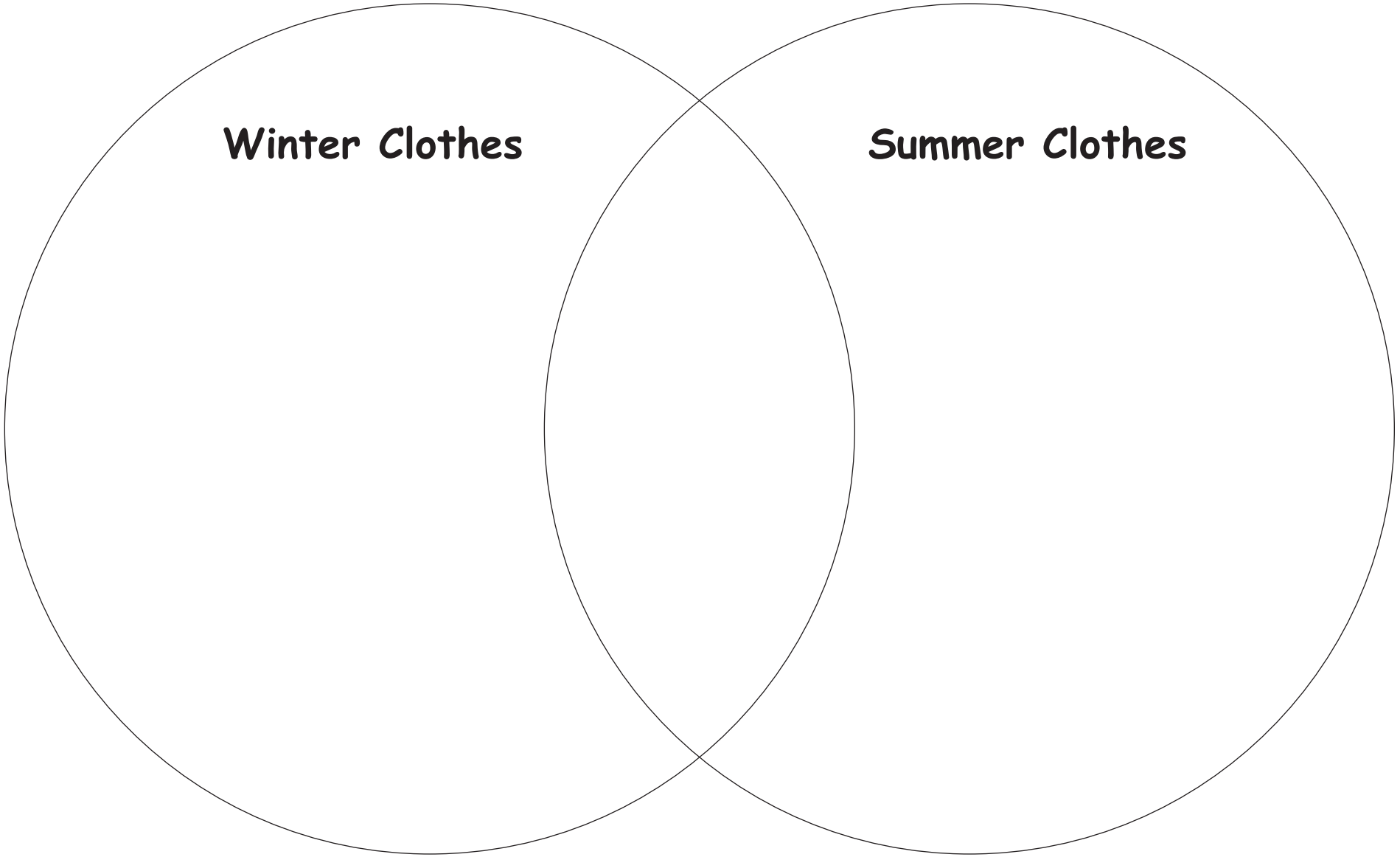
We have been learning about organizing data in order to gather information. The class has completed an activity called Lost and Found in which they identified different categories of lost items in a school (e.g., pieces of clothing, toys, sports equipment), and organized data in order to compare the numbers of items in the different categories.

Ask your child to tell you about the activity and what he or she learned about organizing data. Here are some questions that you might ask:

- What was the Lost and Found activity about?
- What did you do in this activity?
- What categories of lost items did you identify?
- How did you find the category of items that students lost most often?
- How did you find the category of items that students lost least often?
- What kind of graph did you create to show the data?
- What did the graph show about Lost and Found items?
- What could students do to reduce the number of items that are lost?

Thank you for reviewing this activity with your child.

Venn Diagram



A Good Night's Sleep

BIG IDEA **Data Relationships**

CURRICULUM EXPECTATIONS

Students will:

- read primary data presented in charts, tables, and graphs (including vertical and horizontal bar graphs), then describe the data using comparative language, and describe the shape of the data (e.g., "Most of the data are at the high end."; "All of the data values are different.");
- interpret and draw conclusions from data presented in charts, tables, and graphs;
- demonstrate an understanding of mode (e.g., "The mode is the value that shows up most often on a graph."), and identify the mode in a set of data.

MATERIALS

- teacher-made line plot titled "How Much Sleep Did We Get Last Night?" Draw the graph on chart paper, according to the diagram on p. 124 (without the X's, which students will add to the "empty" graph during Getting Started)
- DR3.BLM1: Recommended Hours of Sleep per Night (1 per group of 3 students)
- lined paper
- DR3.BLM2: How Much Sleep Do You Usually Get? (1 per group of 3 students)
- DR3.BLM3: How Long Do Animals Sleep? (1 per student)

ABOUT THE MATH

Interpreting graphs often involves comparing the amount of data in different categories in the graphs. In Grade 3, students examine line plots and bar graphs in order to determine how the data are distributed across the different categories in the graph. By observing where the data occur, students are able to draw conclusions about information presented in the graph.

In Grade 3, students learn that finding the mode of a set of data is helpful in describing where most of the data occur.

GETTING STARTED

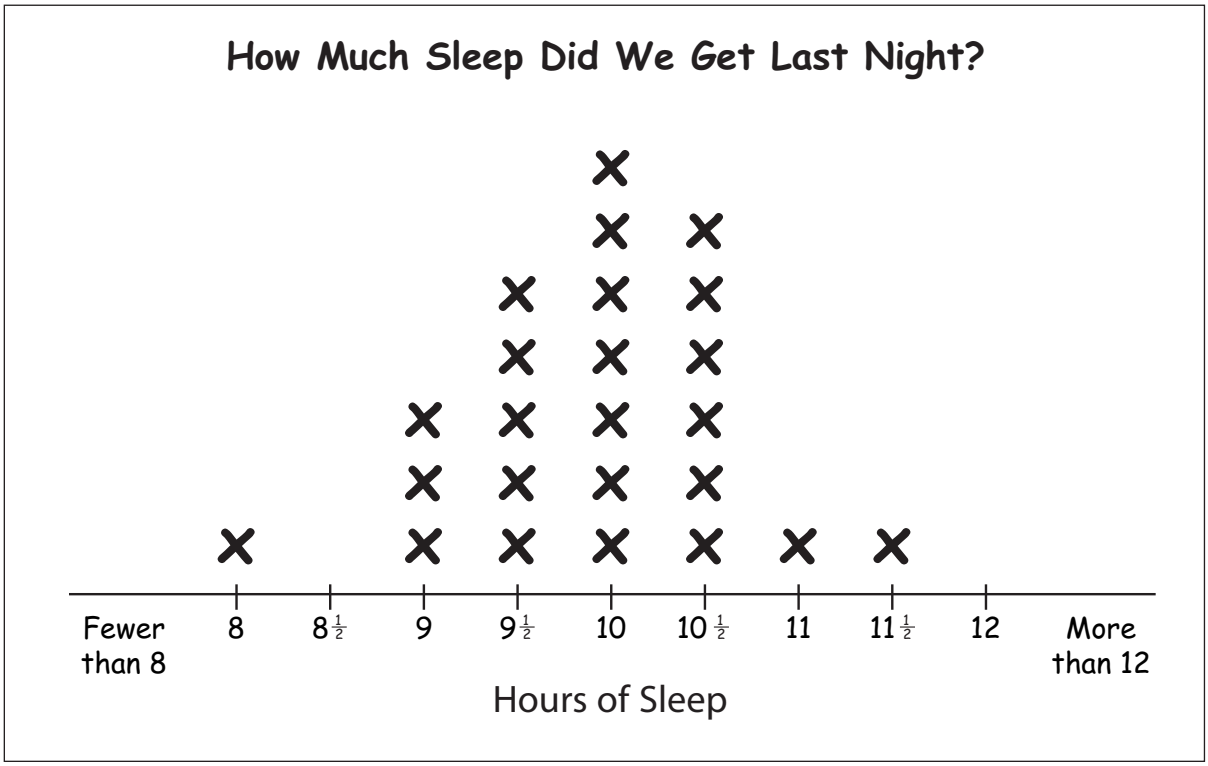
Begin the discussion by asking students the following questions:

- "Are you tired today? Why are you tired?"
- "Do you feel rested? Why do you feel rested?"

Explain that it is important for everyone to get enough sleep every night. Ask: "How can you figure out the number of hours of sleep you had last night?" Ask students to explain their strategies. Together, try different strategies for finding the number of hours of sleep for a child who went to sleep at 8:30 p.m. and woke up at 7:00 a.m. For example, students might examine the face of a clock, and find that the child slept $3\frac{1}{2}$ hours before midnight and 7 hours after midnight, for a total of $10\frac{1}{2}$ hours.

Divide students into groups of three, and have them figure out the approximate number of hours each student in their group slept the previous night. Ask students to round their times for falling asleep and awakening to the nearest half hour.

Show students an "empty" line plot drawn on chart paper (i.e., the graph illustrated below without the X's). Discuss the title and labels on the horizontal axis, and have students predict how the graph will be used. Next, ask each student to record an X in a column to show his or her hours of sleep.



WORKING ON IT

Ask students to explain what they observe in the line plot. Ask the following questions:

- "What is the most sleep a student had? How do you know?"
- "What is the fewest hours of sleep a student had? How do you know?"
- "How many hours of sleep did most students have? How do you know?"

- "Where are most of the data? Why?"
- "What does the line plot tell you about the number of hours of sleep students had last night?"

Discuss the meaning of "mode" – the value that occurs most often in a set of data. Ask students to identify the mode in the graph (i.e., the number of hours of sleep had by most students).

Have a brief conversation about the importance of getting enough sleep. Ask: "Do you think that students in our class had enough hours of sleep?"

Have students continue to work in their groups of three. Provide each group with a copy of DR3.BLM1: Recommended Hours of Sleep per Night. Provide time for groups to discuss what the bar graph shows, and then have students explain their findings about recommended hours of sleep to the class. For example, students might observe that:

- children aged 5 to 12 years should get 10 hours of sleep;
- older people need less sleep than younger people;
- babies need twice as much sleep as adults.

Ask groups to discuss the following question: "According to the data in this graph, how many students in our class got enough sleep last night?" Have students answer the question by referring to the data in both the class-made line plot and DR3.BLM1: Recommended Hours of Sleep per Night.

Provide each group with a copy of DR3.BLM2: How Much Sleep Do You Usually Get? and a sheet of lined paper. Explain that the graph was completed by a different class. Instruct groups to examine the data and to record information presented in the graph.

As students work, ask questions, such as the following:

- "What does the graph tell you?"
- "What is the most sleep that a student usually gets? How do you know?"
- "What is the fewest hours of sleep that a student usually gets? How do you know?"
- "How many hours of sleep do most students get? How do you know?"
- "Where are most of the data?"
- "What is the mode of the data?"
- "How old do you think these students are? Why do you think they are that age?"

After groups have recorded information presented in the graph, let them know that the graph was completed by students who are 14 years old. Challenge groups to use this

information to make other conclusions about the data. For example, students might refer to DR3.BLM1: Recommended Hours of Sleep per Night, and determine whether most students had the recommended number of hours of sleep.

REFLECTING AND CONNECTING

Ask groups to share their information with the class. Encourage them to explain how the data in graphs allowed them to make observations and conclusions. Ask questions, such as the following:

- "What does the graph tell you?"
- "What is the most sleep that a student had?"
- "What is the fewest hours of sleep?"
- "How many hours of sleep did most students have?"
- "Considering that students are 14 years old, what conclusions can you make about the amount of sleep they get?"

Help students to reflect on the experience by asking questions, such as:

- "What kinds of graphs did we use to get information?"
- "How did we use the graphs to get information?"
- "How could we use the information from the graphs to make decisions?"

ADAPTATIONS/EXTENSIONS

Some students might have difficulty interpreting and relating data from the class-made line plot, DR3.BLM1: Recommended Hours of Sleep per Night, and DR3.BLM2: How Much Sleep Do You Usually Get? Simplify the task for these students by having them explain (orally or in writing) information presented in only the class-made line plot.

Extend the activity by having students write a report about their findings in the class-made line plot. Ask them to include recommendations to the class about getting enough hours of sleep. Have students share their report and recommendations with the class. A few days later, have students collect and organize data in order to determine whether more students in the class followed recommendations about hours of sleep.

MATH LANGUAGE

- line plot
- bar graph
- data
- mode
- conclusion, conclude

ASSESSMENT

Observe students throughout the activity to assess how well they interpret and draw conclusions from data presented in graphs. Watch and listen to students in order to determine how well they:

- describe the amount of data in different categories in graphs;
- describe where most of the data in a graph occur, and demonstrate an understanding of mode;
- describe the data using comparative language (e.g., more, fewer, most, least);
- draw conclusions based on information presented in graphs.

HOME CONNECTION

Provide an opportunity for parents and students to discuss information in a graph by sending home DR3.BLM3: How Long Do Animals Sleep?

LEARNING CONNECTION 1

Interpreting Data

Provide opportunities for students to use charts, tables, and graphs in different subject areas. Pose questions, such as the following, to assist students in reading and interpreting charts, tables, and graphs.

- "What is the title of the chart (table, graph)?"
- "What do the labels and numbers on the chart (table, graph) mean?"
- "What does the chart (table, graph) tell us?"
- "Which has the most? the least? Why do you think so?"
- "Which are more (fewer) than _____? Why?"
- "Are there more _____ or _____?"
- "How many _____ and _____ are there altogether?"
- "Is there anything about the data that surprises you?"
- "Does this chart (table, graph) provide us with all the information we want to know?"

LEARNING CONNECTION 2

Secret Rules

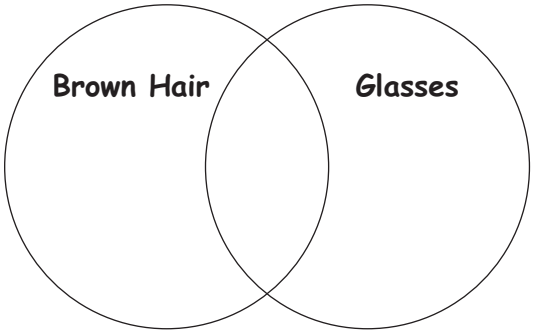
Tell students that you are thinking of two secret rules for sorting students. Explain you will sort students according to these secret rules, and that they need to determine both sorting rules.

Ask three or four students who fit the first rule (e.g., has brown hair) to stand together to form a group. Next, have three or four students who fit the second rule (e.g., wears glasses) form another group. Identify a student who fits both rules (e.g., has brown hair

and wears glasses). Tell the class that this student belongs to both groups, and ask the student to stand in an area between both groups.

Continue to place students, one by one, in a group (or in the area between both groups). From time to time, ask students if they can determine the secret rules. Remind students that they need to be sensitive to their classmates' feelings when they explain possible secret rule (i.e., students should avoid suggesting a secret rule that might embarrass a classmate). After students identify the secret rules, have students check that all students have been placed in the appropriate groups.

Discuss how a Venn diagram might be used to represent the sorting activity. Draw a Venn diagram on the board.



Have students determine where classmates' names should be recorded on the diagram.

LEARNING CONNECTION 3

Finding the Mode in a Set of Data

Materials

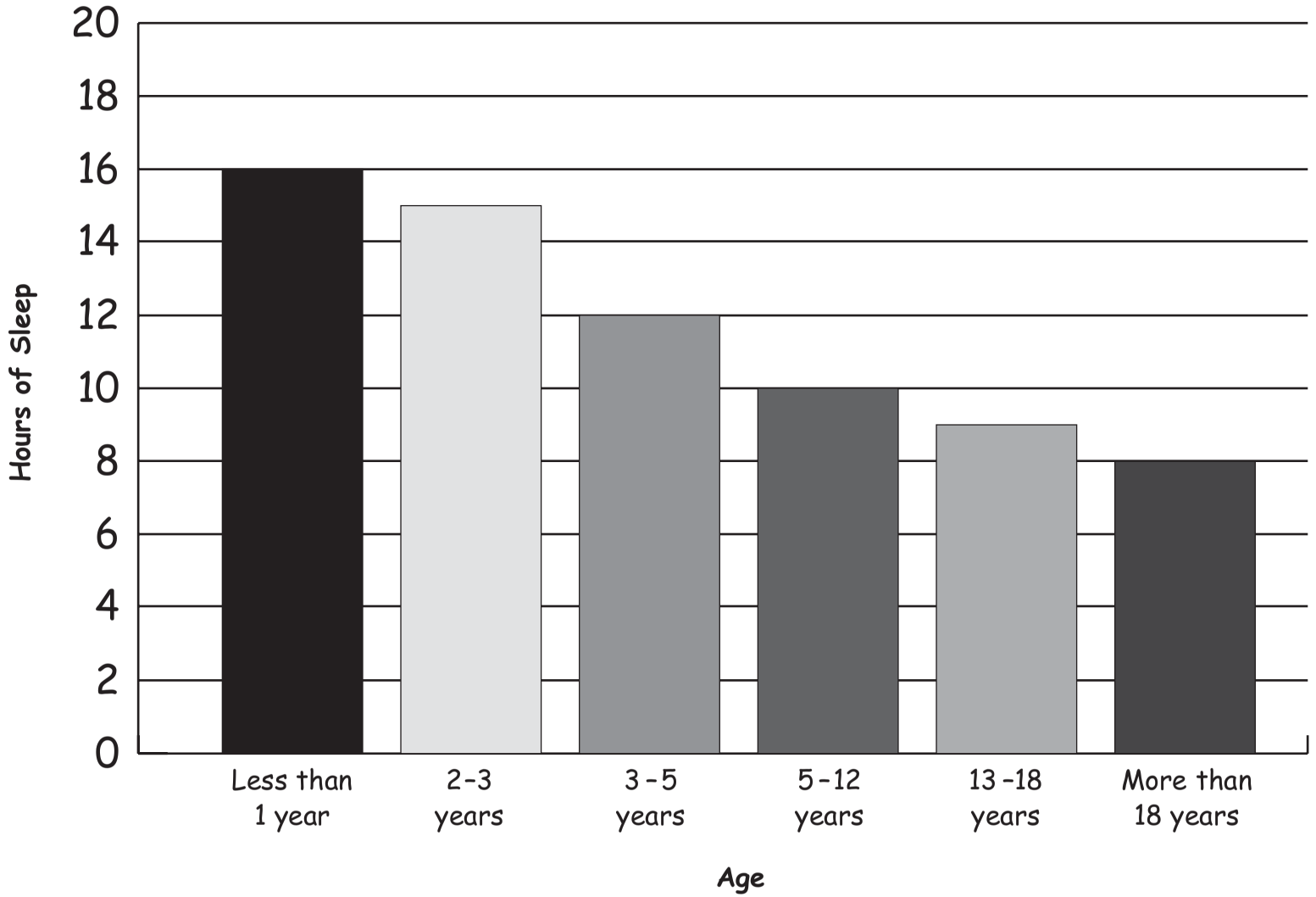
- sheets of paper (a few per group of 5 to 6 students)

Divide students into groups of five or six, and provide each group with a few sheets of paper. Instruct all students in a group to record their age on the same sheet of paper. Ask: "What are the different numbers on your group's sheet of paper? What is the lowest number? What is the highest number? Which number occurs most often?" Explain that the number that occurs most often is called the mode. Have groups circle the mode in the set of data about classmates' ages.

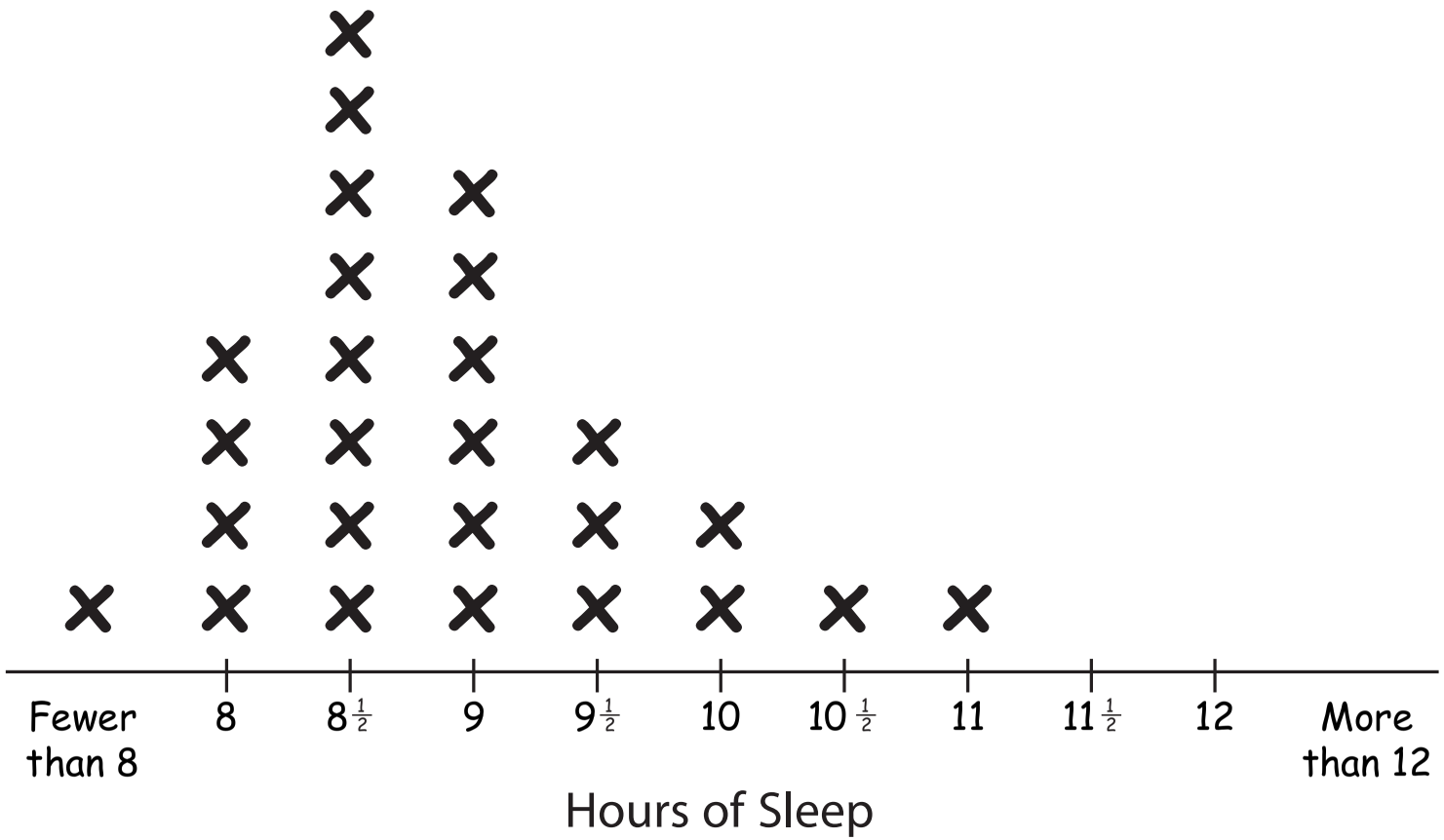
Repeat the activity by having groups generate other sets of data, and asking them to identify the mode. For example, students might work with the following data:

- number of siblings
- number of pets
- number of grandparents
- number of pockets on clothing

Recommended Hours of Sleep per Night



How Much Sleep Do You Usually Get?



How Long Do Animals Sleep?

Dear Parent/Guardian:

In math class, we have been learning about obtaining information from graphs.

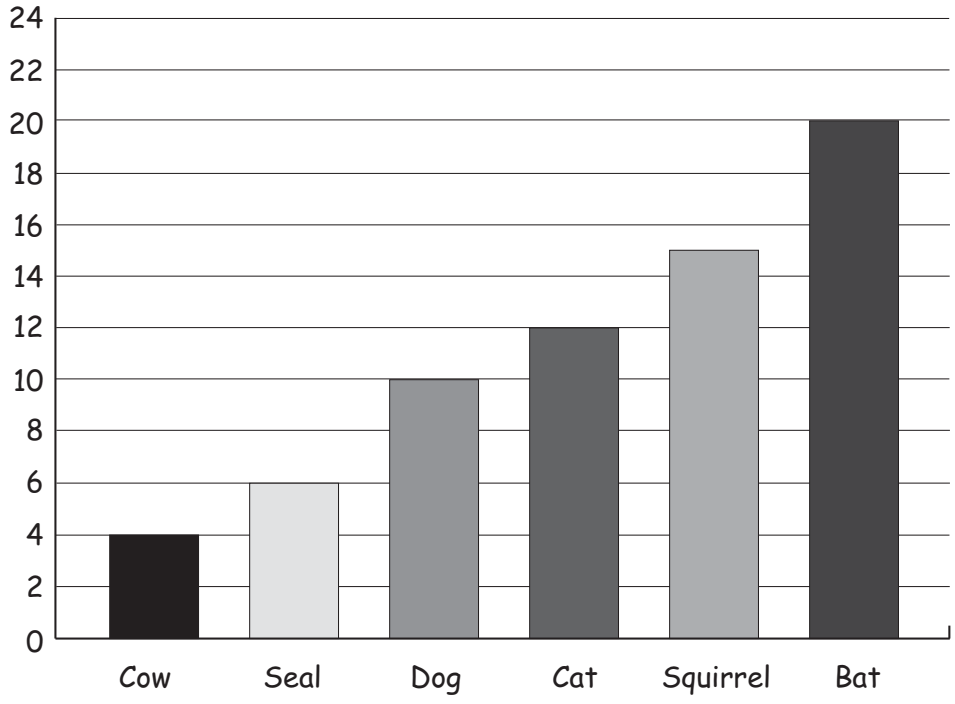
Spend some time with your child talking about the graph below. Discuss information in the graph by asking questions, such as the following:

- Which animal sleeps the most?
- Which animal sleeps the least?
- Which animal sleeps more, a dog or a cat?
- About how many hours per day is a cow awake?

If you have access to the Internet, you and your child might research how long other animals sleep. Have your child create a graph using this new information.

Thank you for helping your child understand how a graph can present information.

How Long Do Animals Sleep?



Grade 3 Learning Activity: Probability

Take Off

BIG IDEA **Probability**

CURRICULUM EXPECTATIONS

Students will:

- predict the frequency of an outcome in a simple probability experiment or game (e.g., "I predict that an even number will come up 5 times and an odd number will come up 5 times when I roll a number cube 10 times."), then perform the experiment, and compare the results with the predictions, using mathematical language;
- demonstrate, through investigation, an understanding of fairness in a game and relate this to the occurrence of equally likely outcomes.

MATERIALS

- Prob3.BLM1: Take Off Game Cards (1 game card per student)
- counters (12 per student)
- regular dice (1 die per pair of students)
- a collection of non-standard dice (e.g., number cubes with 2 to 7, 3 to 9, or 4 to 10; 4-, 5-, 6-, and 8-sided dice)
- Prob3.BLM2: *A, B, or C?* (1 per student)

ABOUT THE MATH

An understanding of probability depends on identifying all possible outcomes in an event (i.e., what could happen) and determining the likelihood of each outcome. To develop this understanding, students need opportunities to conduct simple experiments in which they think about what might occur (by considering all possible outcomes), and make predictions about what will occur (based on their understanding of probability).

GETTING STARTED

Ask students to stand and to think of a number from 1 to 10. Tell them that they may not change their number during the game they are about to play. After students have chosen a number, explain that you will roll a regular die, and that students are to sit down when their number shows on the die. Roll the die several times, announcing the number shown on the die each time.

After each number from 1 to 6 has been called at least once, comment: "We still have some students standing. I think I will need to keep rolling the die, so that their numbers will come up too." Invite students to explain whether they agree with the strategy.

Students might comment that the strategy will not work because the die will not show the numbers (i.e., 7 to 10) of students who are still standing.

WORKING ON IT

Demonstrate the Take Off game to the class:

- Students play the game with a partner. Each player needs a game card from Prob3.BLM1: Take Off Game Cards and 12 counters.
- Players place their counters in any columns on the game card. Players decide in which columns they place their counters. For example, they might place one or more counters in some columns, and place no counters in other columns.
- Players take turns rolling a die. They remove a counter if it is in a number column that matches the number shown on the die. They do not remove a counter if there are no counters in column that matches the number shown on the die.
- The first player who removes all his or her counters wins the game.

Have students play the game with a regular die two or three times. Next, invite pairs to play the game using a non-standard die (e.g., a number cube with 4 to 10, a number cube with even numbers from 2 to 12, a die with more than 6 faces).

As students play the game, ask questions, such as the following:

- "Why did you place a counter/counters in this column?"
- "Why did you not place counters in this column?"
- "What strategy are you using to help you win the game?"
- "How would you change your strategy if the die had the numbers from 3 to 9 on it?"

REFLECTING AND CONNECTING

Discuss the game with students by asking the following questions:

- "What was easy about the game? What was difficult?"
- "Did you roll a certain number more often than others? Why do you think this happened?"
- "How did you decide where to place the counters on the game card the first time you played the game?"
- "How did you decide where to place the counters on the game card after you played the game a few times?"
- "What strategy did you use to help you win the game? Why did you use this strategy?"
- "Did your strategy work in every game? Why or why not?"
- "How did you change your strategy when you used a non-standard die?"
- "How would you change your strategy if you played the game again?"

As students discuss the game, listen to their ideas about the game and strategies for playing it. Assess whether they demonstrate an understanding of possible outcomes for each kind of die or number cube, the likelihood of rolling numbers on the die or number cube (e.g., every number has an equal chance of being rolled), and the role of chance in the game (e.g., there is no way to predict which number will be rolled).

ADAPTATIONS/EXTENSION

Some students may demonstrate little understanding of possible outcomes of rolling the die or number cube, or of the equal chance of rolling any number on the die or number cube. Ask these students to examine the die or number cube and tell which numbers appear on it. Provide them with simple probability experiments (e.g., rolling a die or number cube several times and keeping a tally of the numbers rolled).

Extend the game by having students play variations of the Take Off game:

- Players may remove a counter only if the number rolled is even (or odd).
- Players add 1 (or subtract 1) to the number rolled and remove a counter in a corresponding column.
- Players double the number rolled and remove a counter in a corresponding column.
- On each turn, a player may move a counter to a different column before rolling the die or number cube.

MATH LANGUAGE

- outcome
- chance
- likely
- unlikely
- impossible
- certain

ASSESSMENT

Discussing the game with students provides an opportunity to assess their understanding of possible outcomes, the likelihood of obtaining each outcome (i.e., all numbers on a die or number cube have an equal chance of being rolled), and the role of chance (e.g., there is no fair way to control which number will be rolled, nor is it possible to predict which number will be rolled).

Observe the strategies students use in the game. Do their strategies show an understanding of probability (i.e., all numbers on the die or number cube have an equal chance of being rolled), or do their strategies indicate misconceptions about chance (e.g., placing counters in specific columns according to "lucky" numbers)?

HOME CONNECTION

Send home Prob3.BLM2: *A, B, or C?* This game provides an opportunity for parents and students to explore concepts about probability.

LEARNING CONNECTION 1

More Red or More Blue?

Materials

- paper bags (1 per pair of students)
- interlocking cubes (2 colours of cubes for each pair)

Ahead of time, put 2 red cubes and 8 blue cubes into a paper bag, without showing the class. Explain to students that the bag contains red cubes and blue cubes and that there is more of one colour than of the other. Ask them to predict whether there are more red cubes or blue cubes. Instruct students to record "Red" and "Blue" on a sheet of paper, and have them circle a colour to show their prediction.

Draw cubes from the bag, one at a time, and show them to students. Return each cube to the bag after it is drawn. Have students keep a tally of the number of times a colour is drawn from the bag:

Red |||

Blue 𝍸

After drawing and replacing 10 cubes from the bag, ask students to describe the results (e.g., red was drawn 3 times, blue was drawn 7 times, blue was drawn more often than red). Do not yet reveal the contents of the bag.

Repeat the experiment using the same cubes in the bag as before. Again, have students record "Red" and "Blue" on their paper, predict whether there are more red cubes or blue cubes in the bag, and circle that colour on their paper. Let students know that they may change their prediction from the last time. Observe whether students revise their predictions based on the results of the previous experiment.

Repeat the process of drawing cubes from the bag 10 times, and having students keep a tally of the colours drawn.

Before conducting the experiment a third time, ask students to predict whether there are more red cubes or blue cubes and to explain their thinking to the class. Listen to their explanations, and assess how well students use the results of previous experiments to make predictions.

After the third experiment, tell students that there are 10 red cubes and blue cubes altogether, and have them predict the number of each colour of cube. Ask them to explain their predictions. Do students base their predictions on the results of the experiment?

Remove the contents from the bag, and have students explain whether their predictions were close to the actual number of red cubes and blue cubes.

Have students work in pairs. Provide each pair of students with a paper bag and two colours of interlocking cubes. Explain how students should conduct the experiment:

- Student A secretly puts 10 cubes into the bag, using different numbers of each colour.
- Student B predicts which colour is more plentiful in the bag.
- Student B keeps a tally of colours, as Student A draws and replaces a cube from the bag 10 times.
- Student B may revise his or her prediction based on the results of the experiment.
- Students conduct the experiment a second and third time.
- Student B predicts the actual number of each colour of cube. Finally, students look at the cubes in the bag and check the prediction.
- Students reverse roles, and conduct the experiment with other combinations of cubes.

LEARNING CONNECTION 2

Taking Your Chances

Materials

- regular die
- sheets of paper (1 per student)
- pencils

Explain the game to students:

- The teacher rolls the die 20 times. After each roll, students add the number indicated on the die to the total obtained in previous rolls. Students may use paper and pencil to help them keep track of their running total.
- If the teacher rolls a 1, students lose their accumulated total, and their score becomes 1. Students continue to add on from 1 in subsequent rolls of the die.
- At any point in the game, students may "freeze" their score by standing up. For example, if a student has achieved a score of 16, he or she may stop at 16 and stand up.
- After the teacher has rolled the die 20 times, the class determines which student has the highest score. Two or more students may have the same high score.

After playing the game a few times, ask questions, such as the following:

- "What strategy did you use to play the game? How did you decide when to freeze your score?"
- "Were you able to predict when a 1 would be rolled? Why or why not?"
- "How likely is it for a 1 to be rolled? Why?"
- "What are the chances that a 1 would be rolled? How do you know that the chances of rolling a 1 are 1 out of 6?"

Take Off Game Cards

1	2	3	4	5	6	7	8	9	10

1	2	3	4	5	6	7	8	9	10

A, B, or C?

Dear Parent/Guardian:

We have been learning about probability in math class. Students make predictions based on their understanding of whether something is likely or unlikely to happen.

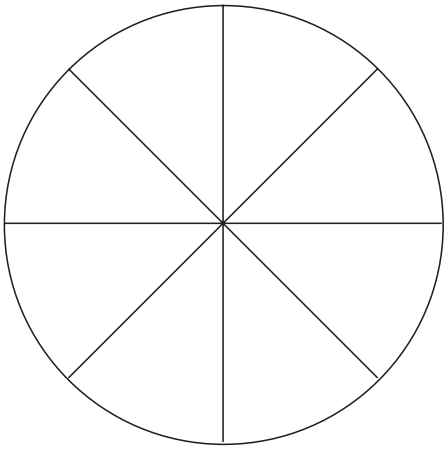
Here is a game to play with your child to help him or her think about probability:

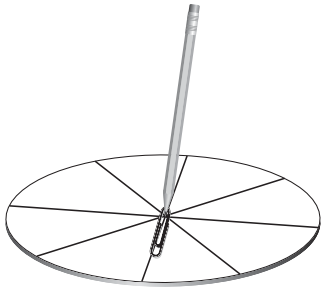
- Use a pencil to lightly print "A", "B", or "C" in each of the sections of the spinner below. For example, you might print "A" in 5 spaces, "B" in 2 spaces, and "C" in 1 space.
- Have your child look at the spinner, and ask him or her to predict on which letter the spinner will land most often. Ask your child to explain his or her prediction.
- Use a paper clip and pencil to make the spinner. Have your child spin the spinner 10 times and keep a tally of the letters on which the spinner lands. The tally might look like this:

A 𝍸 | B ||| C |

- After 10 spins, have your child compare his or her prediction with the outcome of the 10 spins.
- Erase the letters on the spinner. Record a different A-B-C set on the spinner, and play the game again.

Thank you for helping your child learn about probability.





E. Correspondence of the Big Ideas and the Curriculum Expectations in Data Management and Probability

Appendix Contents

Overall Expectations

KINDERGARTEN	GRADE ONE	GRADE TWO	GRADE THREE
Students will:			
• sort, classify, and display a variety of concrete objects, collect data, begin to read and describe displays of data, and begin to explore the concept of probability in everyday contexts.	• collect and organize categorical primary data and display the data using concrete graphs and pictographs, without regard to the order of labels on the horizontal axis; • read and describe primary data presented in concrete graphs and pictographs; • describe the likelihood that everyday events will happen.	• collect and organize categorical or discrete primary data and display the data, using tally charts, concrete graphs, pictographs, line plots, simple bar graphs, and other graphic organizers, with labels ordered appropriately along horizontal axes, as needed; • read and describe primary data presented in tally charts, concrete graphs, pictographs, line plots, simple bar graphs, and other graphic organizers; • describe probability in everyday situations and simple games.	• collect and organize categorical or discrete primary data and display the data using charts and graphs, including vertical and horizontal bar graphs, with labels ordered appropriately along horizontal axes, as needed; • read, describe, and interpret primary data presented in charts and graphs, including vertical and horizontal bar graphs; • predict and investigate the frequency of a specific outcome in a simple probability experiment.

Specific Expectations in Relation to the Big Ideas

KINDERGARTEN	GRADE ONE	GRADE TWO	GRADE THREE
Big Idea: Big Idea: Collection and Organization of Data **Students will:**			
– sort, classify, and compare objects and describe the attributes used *(e.g., **initially:** sort them into piles or collections on the basis of a common attribute; **eventually:** state the rule they used to sort, classify, or compare)*; – collect objects or data and make representations of their observations, using concrete graphs *(e.g., conduct simple surveys and use graphs to represent the data collected from questions posed; use a variety of graphs, such as graphs using people to represent things, bar graphs, pictographs; use tally charts)*.	– demonstrate an ability to organize objects into categories by sorting and classifying objects using one attribute (e.g., colour, size), and by describing informal sorting experiences (e.g., helping to put away groceries); – collect and organize primary data (e.g., data collected by the class) that is categorical (i.e., that can be organized into categories based on qualities such as colour or hobby), and display the data using one-to-one correspondence, prepared templates of concrete graphs and pictographs (with titles and labels), and a variety of recording methods (e.g., arranging objects, placing stickers, drawing pictures, making tally marks).	– demonstrate an ability to organize objects into categories, by sorting and classifying objects using two attributes simultaneously (e.g., sort attribute blocks by colour and shape at the same time); – gather data to answer a question, using a simple survey with a limited number of responses (e.g., What is your favourite season?; How many letters are in your first name?); – collect and organize primary data (e.g., data collected by the class) that is categorical or discrete (i.e., that can be counted, such as the number of students absent), and display the data using one-to-one correspondence in concrete graphs, pictographs, line plots, simple bar graphs,	– demonstrate an ability to organize objects into categories, by sorting and classifying objects using two or more attributes simultaneously; – collect data by conducting a simple survey about themselves, their environment, issues in their school or community, or content from another subject; – collect and organize categorical or discrete primary data and display the data in charts, tables, and graphs (including vertical and horizontal bar graphs), with appropriate titles and labels and with labels ordered appropriately along horizontal axes, as needed, using many-to-one correspondence (e.g., in a pictograph, one car sticker

KINDERGARTEN	GRADE ONE	GRADE TWO	GRADE THREE
Big Idea: Collection and Organization of Data (*cont.*) **Students will:**			
		and other graphic organizers (e.g., tally charts, diagrams), with appropriate titles and labels and with labels ordered appropriately along horizontal axes, as needed.	represents 3 cars; on a bar graph, one square represents 2 students).
Big Idea: Data Relationships **Students will:**			
– respond to and pose questions about data collection and graphs.	– read primary data presented in concrete graphs and pictographs, and describe the data using comparative language (e.g., more students chose summer than winter as their single favourite season); – pose and answer questions about collected data.	– read primary data presented in concrete graphs, pictographs, line plots, simple bar graphs, and other graphic organizers (e.g., tally charts, diagrams), and describe the data using mathematical language (e.g., "Our bar graph shows that 4 more students walk to school than take the bus."); – pose and answer questions about class-generated data in concrete graphs, pictographs, line plots, simple bar graphs, and tally charts (e.g., Which is the least favourite season?); – distinguish between numbers that represent data values (e.g., "I have 4 people in my family.") and numbers that represent the frequency of an event (e.g., "There are 10 children in my class who have 4 people in their family."); – demonstrate an understanding of data displayed in a graph (e.g., by telling a story, by drawing a picture), by comparing different parts of the data and by making statements about the data as a whole (e.g., "I looked at the graph that shows how many students were absent each month. More students were away in January than in September.").	– read primary data presented in charts, tables, and graphs (including vertical and horizontal bar graphs), then describe the data using comparative language, and describe the shape of the data (e.g., "Most of the data are at the high end."; "All of the data values are different."); – interpret and draw conclusions from data presented in charts, tables, and graphs; – demonstrate an understanding of mode (e.g., "The mode is the value that shows up most often on a graph."), and identify the mode in a set of data.

KINDERGARTEN	GRADE ONE	GRADE TWO	GRADE THREE
Big Idea: Probability **Students will:**			
– use mathematical language in informal discussions to describe probability *(e.g., chance, never, sometimes, always)*.	– describe the likelihood that everyday events will occur, using mathematical language (i.e., *impossible, unlikely, less likely, more likely, certain*) (e.g., "It's unlikely that I will win the contest shown on the cereal box.").	– describe probability as a measure of the likelihood that an event will occur, using mathematical language (i.e., *impossible, unlikely, less likely, equally likely, more likely, certain*) (e.g., "If I take a new shoe out of a box without looking, it's equally likely that I will pick the left shoe or the right shoe."); – describe the probability that an event will occur (e.g., getting heads when tossing a coin, landing on red when spinning a spinner), through investigation with simple games and probability experiments and using mathematical language (e.g., "I tossed 2 coins at the same time, to see how often I would get 2 heads. I found that getting a head and a tail was more likely than getting 2 heads.").	– predict the frequency of an outcome in a simple probability experiment or game (e.g., "I predict that an even number will come up 5 times and an odd number will come up 5 times when I roll a number cube 10 times."), then perform the experiment, and compare the results with the predictions, using mathematical language; – demonstrate, through investigation, an understanding of fairness in a game and relate this to the occurrence of equally likely outcomes.

Glossary

Note: Words and phrases in boldface italics in the following definitions are also defined in the glossary.

assessment. The ongoing, systematic gathering, recording, and analysis of information about a student's achievement, using a variety of strategies and tools. Its intent is to provide feedback to the teacher (and to the student, where appropriate) that can be used to improve programming.

attribute. A quantitative or qualitative characteristic of a shape, an object, or an occurrence; for example, colour, size, thickness, or number of sides.

attribute blocks. Learning tools that help students learn about shapes, sorting, patterning, geometric properties, and so on. The standard set of attribute blocks (60 blocks) includes five shapes (rectangle, square, circle, triangle, hexagon); each shape comes in three colours (red, yellow, blue), two sizes (large small), and two thicknesses (thick, thin).

bar graph. See under ***graph***.

big ideas. In mathematics, the important concepts or major underlying principles. For example, the big ideas for Kindergarten to Grade 3 in the Data Management and Probability strand of the Ontario Curriculum are collection and organization of ***data***, data ***relationships***, and ***probability***.

Carroll diagram. A chart that displays yes/no categorical data.

	Mammal	Not a Mammal
Has Four Legs	horse elephant	frog toad
Does Not Have Four Legs	whale seal	duck trout

categorical data. Data that can be sorted by type or quality, rather than by counted values. Eye colour and favourite food are examples of categorical data.

circle graph. See under ***graph***.

concrete graph. See under ***graph***.

concrete material. See ***manipulative***.

concept. See ***mathematical concept***.

context. The environment, situation, or setting in which an event or activity takes place. Real-life settings often help students make sense of mathematics.

data. Facts or information. *See also* ***categorical data*** *and* ***discrete data***.

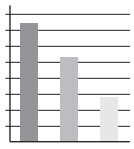
discrete data. Data that can include only certain numerical values (often whole numbers) within the range of the data. Discrete data usually represent things that can be counted; for example, the number of times a word is used or the number of students absent.

expectations. The knowledge and skills that students are expected to learn and to demonstrate by the end of every grade or course, as outlined in the Ontario curriculum documents for the various subject areas.

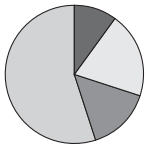
extension. A learning activity that is related to a previous one. An extension can involve a task that reinforces, builds on, or requires application of newly learned material.

graph. A visual representation of data. Some types of graphs are:

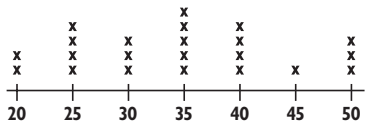
- **bar graph.** A graph consisting of horizontal or vertical bars that represent the frequency of an event or ***outcome***. There are gaps between the bars to reflect the ***categorical*** or ***discrete*** nature of the ***data***.



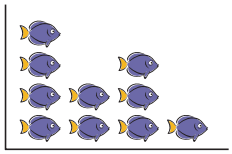
- **circle graph.** A graph in which a circle is used to display categorical data, through the division of the circle proportionally to represent each category.



- **concrete graph.** A graph in which real objects are used to represent pieces of information; for example, coloured candy directly placed on a template of a bar graph.
- **line plot.** A graph that shows a mark (usually an "X") above a value on the number line for each entry in the data set.



- **people graph.** A graph in which people themselves represent the data. To create a people graph, students arrange themselves into columns according to the categories in the graph.
- **pictograph.** A graph that uses pictures or symbols to compare frequencies.



glyph. A pictorial display in which colours and/or symbols represent information.

people graph. See under **graph**.

independence of events. The idea that one event in a probability situation does not affect the probability of the other event(s) (e.g., rolling a 6 on a die does not influence which number will be obtained on subsequent rolls of the number cube).

investigation. An instructional activity in which students pursue a problem or exploration. Investigations help students to develop problem-solving skills, learn new concepts, and apply and deepen their understanding of previously learned concepts and skills.

likelihood. The chance of something happening. The likelihood of an event can be described as impossible, likely, or certain.

line plot. See under ***graph***.

links. Commercially produced learning tools consisting of interconnecting plastic rings that are similar in appearance to chain links. Students can use links to create ***concrete graphs***, create patterns, and investigate number ***concepts***.

learning styles. Different ways of learning and processing information. For instance, visual learners need to see visual representations of concepts. Auditory learners learn best through verbal instructions and discussions, and by talking things through and what others have to say. Tactile/kinaesthetic learners learn best through a hands-on approach, and by exploring the physical world around them.

manipulative. (Also called "concrete material".) Objects that students handle and use in constructing or demonstrating their understanding of ***mathematical concepts*** and skills. Some examples of concrete materials are counters, interlocking cubes, and colour tiles.

many-to-one correspondence. The correspondence of more than one object to a single symbol or picture. For example, on a pictograph, five cars can be represented by one sticker. *See also* ***one-to-one correspondence***.

mathematical concept. A fundamental understanding about mathematics that a student develops within problem-solving ***contexts***.

mean. A measure used to describe how the pieces in a set of data are centred. The mean of a set of numbers is found by dividing the sum of the numbers by the number of numbers in the set. For example, the mean of 10, 20, and 60 is (10 + 20 + 60) ÷ 3 = 30.

median. The middle value in a set of values arranged in order. For example, 14 is the median for the set of numbers 7, 9, 14, 21, 39. If there is an even number of numbers, the median is the average of the two middle numbers. For example, 11 is the median of 5, 10, 12, and 28.

mode. The value that occurs most often in a set of data. For example, in a set of data with the values 3, 5, 6, 5, 6, 5, 4, 5, the mode is 5.

one-to-one correspondence. The correspondence of one object to one symbol or picture. In counting, one-to-one correspondence is the idea that each object being counted must be given one count and only one count. *See also* ***many-to-one correspondence***.

outcome. One of the possible events in a ***probability*** experiment or game (e.g., when tossing a coin there are two possible outcomes, heads or tails).

pattern blocks. Commercially produced learning tools consisting of green triangles, orange squares, tan rhombuses, and larger blue rhombuses, red trapezoids, and yellow hexagons.

pictograph. See under ***graph***.

primary data. Information that is collected directly or first-hand; for example, observations and measurements collected directly by students through ***surveys*** and experiments. Also called *first-hand data or primary-source data. See also* ***secondary data***.

probability. A number from 0 to 1 that shows how likely it is that an event will happen.

problem solving. Engaging in a task for which the solution is not obvious or known in advance. To solve the problem, students must draw on their previous knowledge, try different strategies, make connections, and reach conclusions. Learning to solve problems by inquiry or ***investigation*** is very natural for young students.

random. Having an equal chance. In a ***probability*** experiment, ***outcomes*** are random if they all have the same chance of occurring.

relationship. In mathematics, a connection between ***mathematical concepts***, or between a ***mathematical concept*** and an idea in another subject or in real life. As students connect ideas they already understand with new experiences and ideas, their understanding of mathematical relationships develops.

representation. The use of ***manipulatives***, diagrams, pictures, or symbols to model a ***mathematical concept*** or real-world ***context*** or situation.

scale (on a graph). A sequence of numbers associated with marks that subdivide an axis. An appropriate scale is chosen to ensure that all ***data*** are represented on the ***graph***.

secondary data. Information that is not collected first-hand; for example, ***data*** from a magazine, a newspaper, a government document, or a database. Also called *second-hand data* or *secondary-source data. See also* ***primary data***.

shape of data. The shape of a ***graph*** that represents the distribution of a set of ***data***.

simple probability experiment. An experiment with the same possible ***outcomes*** each time it is repeated, but for which no single ***outcome*** is predictable; for example, tossing a coin, rolling a number cube.

strand. A major area of knowledge and skills. In the Ontario mathematics curriculum for Grades 1–8, there are five strands: Number Sense and Numeration, Measurement, Geometry and Spatial Sense, Patterning and Algebra, and Data Management and Probability.

s**urvey.** A record of observations gathered from a sample of a population. For example, observations may be gathered and recorded by asking people questions or interviewing them.

table. An orderly arrangement of facts set out for easy reference; for example, an arrangement of numerical values in vertical columns and horizontal rows.

tally chart. A chart that uses tally marks to count ***data*** and record frequencies.

Venn diagram. A diagram consisting of overlapping and/or nested shapes used to show what two or more sets have and do not have in common.

Parallelograms