

Data Management and Probability

General Curriculum Outcome F:

Students will solve problems involving the collection, display and analysis of data.

GCO F: Students will solve problems involving the collection, display and analysis of data.

KSCO: By the end of grade 6, students will have achieved the outcomes for entry-grade 3 and will also be expected to

i) collect, organize and describe relevant data in multiple ways

SCO: By the end of grade 6, students will be expected to

F1 choose and evaluate appropriate samples for data collection

F2 identify various types of data sources

Elaboration - Instructional Strategies/Suggestions

F1 When gathering information about a large population, it is often not possible to check every member. In such a situation, samples are used to make generalizations about the entire population. Students should recognize that conclusions drawn from the sample may not be perfectly true for the entire population. Samples should be chosen in such a way that minimizes the degree of error.

For example, suppose a student wanted to determine people's favourite take-out food. It would not be wise to choose a sample of patrons of Pizza Palace. Clearly, that sample could be biased in favour of pizza.

In choosing a sample, students should carefully consider the information being sought and how a person answering the question(s) could be biased. For example, if students want to find what radio station is most popular, they should probably consider

- the mix of ages within the sample
- the sex distribution within the sample
- the availability of a variety of stations to those sampled
- the time of day (Some stations are likely more attractive to listeners at a particular time of day).

A sample should be constructed to deal with such potential biases.

F2 Students should realize that although some data is collected first-hand by interviewing or observing, much of the data to which they are exposed is second-hand data. Students should explore, through discussion, how such data might be collected and how reliable they feel it is.

For example, if students read that 30% of children in Canada are not physically fit, what might they wonder about the data source? Was a sample used? Were children tested directly or was data collected by asking doctors or teachers? Students should realize that they must be careful about drawing conclusions from reported data. Becoming familiar with sources for different types of data is valuable to students as it will help further develop their research skills.

Note: These outcomes may be integrated with other curriculum areas where possible (e.g., science, social studies, etc.).

GCO F: Students will solve problems involving the collection, display and analysis of data.

Worthwhile Tasks for Instruction and/or Assessment*Interview*

F1.1 Ask students to explain why bias may be present in a survey which measures arm span and leg length in your class if only male students are surveyed.

F1/2.1 Ask students what sample/data source they would use to determine the amount of milk an average Grade 6 student drinks each day.

F1.2 Ask: How would you construct a sample to interview in order to predict an election result?

F2.1 Ask students where they might go to find data about the number of school-aged children in their province.

F1.3 Ask students why a sample of 5-year-olds might not be the best one to find out what playground equipment a school should have.

Presentation

F1/2.2 Ask students to locate a media story which presents numerical information of some sort about Canadians. The students are to tell how they believe the data was collected and whether or not they believe the public can be reasonably certain that the data is reliable.

Project

F1/2.3 Ask students to collect a sample in order to predict how many people in their community or school have a particular attribute such as blue eyes, blond hair, like chocolate milk, have an allergy, etc. Ask them to justify their predictions.

Journal

F1.4 Ask students to describe a situation in which they feel that a sample might be biased.

Suggested Resources

Statistics Canada

www.statscan.ca

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ii) *construct a variety of data displays (including tables, charts and graphs) and consider their relative appropriateness*

SCO: By the end of grade 6, students will be expected to

F3 plot coordinates in four quadrants

Elaboration - Instructional Strategies/Suggestions

F3 Students should plot data points in all four quadrants.

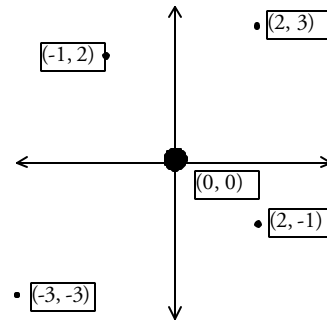
This could be started using linking geoboards. If one board has all the pegs labelled with coordinates and another board is attached to the left, the new pegs must be labelled.

Students should recognize that

- a negative number for the first coordinate indicates that the point is to the left of the vertical axis

- a negative number for the second coordinate indicates that the point is below the horizontal axis

- the point at which the axes intersect has coordinates (0,0) and is known as the origin.

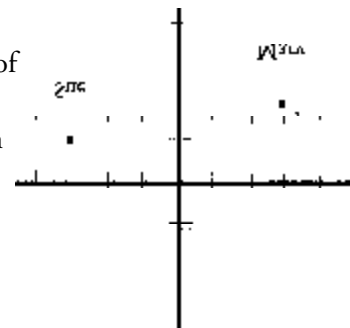


☐ Students might create drawings using all four quadrants of the coordinate grid. They could then provide other students with a list of the vertices, in order, for each drawing created. The other students would subsequently re-create the drawings.

Situations which might be modelled using 4-quadrant graphs include

- high vs low temperatures for different days
- mathematical relationships (e.g., a number vs its double)
- locations, such as the numbers of blocks north, south, east, and west from the town centre.

☐ Show a map (graph) like the one at right. Ask: How many blocks north of town centre does Mary live? How many blocks east? Write Sue's location as an ordered pair. [The origin represents the town centre.]



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Worthwhile Tasks for Instruction and/or Assessment

Suggested Resources

Performance/Activity

F3.1 Using masking tape, create a grid on the floor with the four quadrants (a tiled floor is particularly useful). Ask individual students to locate and stand on the ordered pairs given in F3.3.

F3.2 Ask students to determine what happens to a plotted shape if all the first coordinates are switched with the corresponding second coordinates (e.g., (3,-2) becomes (-2,3)).

Paper and Pencil

F3.3 Ask students to describe the relationship among the points (-4, 2), (-2, 1), (0,0) and (2, -1).

F3.4 Ask the student to describe where each of these points would be located following a half-turn about the origin: (-3, -5), (3, 6), (-2, 4).

F3.5 Ask students to plot 10 points in quadrant 1 for which the difference between the first and second coordinate is 3. Ask them to identify other points along the continuation of this pattern which have coordinates with negative values and to list 3 pairs of such coordinates.

F3.6 Ask students to name 5 coordinate pairs in the top left quadrant of a graph. What do the ordered pairs have in common?

F3.7 Give the coordinates of a triangle (e.g., (1,2), (3,5) and (4,0)). Ask students to reflect the triangle in the horizontal axis and label the coordinates. Repeat in the vertical axis.

Interview/Journal

F3.8 Ask students to plot 10 points for which the first coordinate is the opposite of the second (e.g., (5,-5)). Ask them to describe the pattern they see and explain why they might have expected that pattern.

F3.9 Ask students to plot the scores on the various holes in this mock golf game and then explain how the graph depicts the performance of the player.

| Hole | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|-------|---|----|----|----|---|---|---|---|---|
| Score | 0 | -1 | -2 | -1 | 0 | 1 | 1 | 1 | 0 |

Grid Paper
Geoboards

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ii) construct a variety of data displays (including tables, charts and graphs) and consider their relative appropriateness

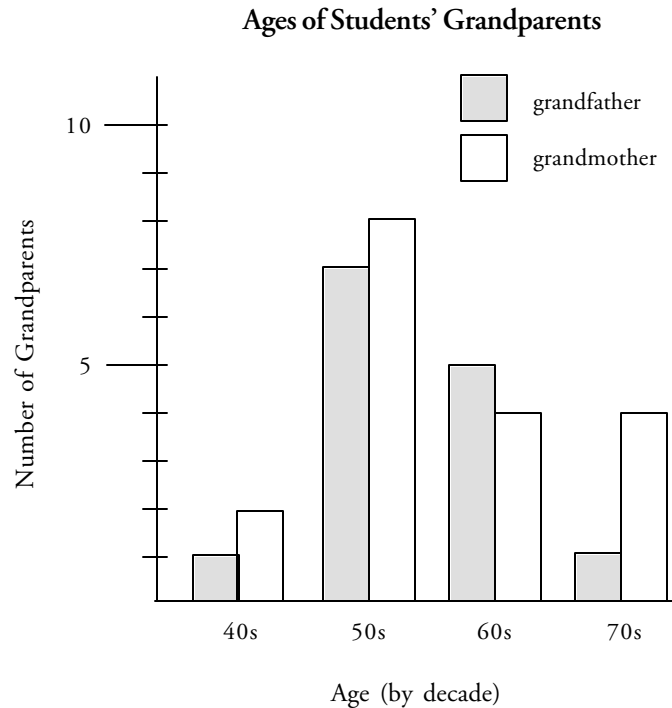
SCO: By the end of grade 6, students will be expected to

F4 use bar graphs, double bar graphs and stem-and-leaf plots to display data

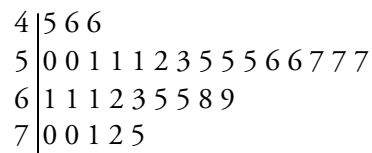
Elaboration - Instructional Strategies/Suggestions

F4 Students should regularly use bar graphs, double bar graphs, and stem-and-leaf plots to display and organize data. Data can be collected in surveys, through experiments or through research. Topics may include areas of mathematics, other curricular areas and real-life situations.

For example, students might gather information about the ages of their grandparents and display it in either a double bar graph or stem-and-leaf plot.



Ages of Students' Grandparents



Note: Students have worked with these data displays in Grades 4 and 5.

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Worthwhile Tasks for Instruction and/or Assessment**Suggested Resources***Performance*

F4.1 Ask students to create a graph which illustrates both the first and second choices of favourite sports of class members.

F4.2 Ask students to draw a bar graph to compare the number of calories used by an adult female in one hour for each activity listed below:

| | |
|----------------|-----|
| Sleeping | 55 |
| Walking | 180 |
| Walking uphill | 360 |
| Running | 420 |

Interview

F4.3 Ask: What scale would you use to graph the following data?

Category A- 25

Category B- 1000

Category C -5000.

F4.4 Ask students to survey their classmates to find out the arm spans of members of the class. Ask a group of students to create a stem-and-leaf plot for each of female arm spans, female leg lengths, male arm spans and male leg lengths. The various graphs could then be compared. Other students could create double bar graphs to contrast male and female data.

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KSCO ii) By the end of grade 6, students will have achieved the outcomes for entry-grade 3 and will also be expected to

ii) *construct a variety of data displays (including tables, charts and graphs) and consider their relative appropriateness*

SCO: By the end of grade 6, students will be expected to

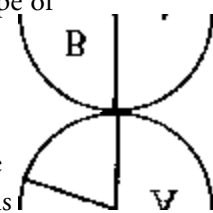
F5 use circle graphs to represent proportions

A “circle” or “pie” graph is used when a total amount has been partitioned into parts and interest is in the ratio of each part to the whole and not so much in the particular quantities. (Elementary School Mathematics, p. 396)

Elaboration - Instructional Strategies/Suggestions

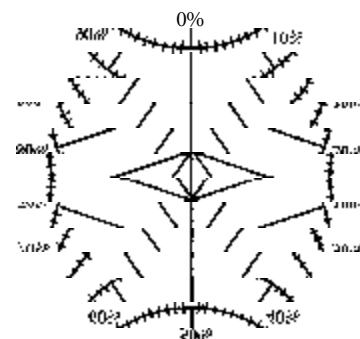
F5 Note: Outcomes A2 to A5 should be addressed prior to this outcome. Construction of a circle graph is a new type of graph for grade 6 students.

Students should realize that circle graphs are used to describe how a whole is distributed into its component parts. Students should be able to estimate percents when shown a circle graph. For example: A is about 50%. B is about 30%. To help students develop these estimation skills, they can overlay circle graphs with transparent circle mats.



There are many ways to construct a circle graph:

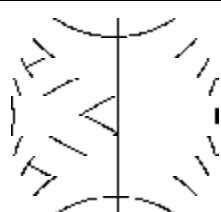
- circle mats divided up into tenths and hundredths



- a strip of equal-sized squares shaded by categories, taped together to make a circle, with lines drawn from the centre of the circle to the positions where the categories change on the strip



- fraction circle pieces



It is important that students understand that a circle graph describes relative size, but not actual size. If, for example, circle graphs were created to show the age distributions of people in Newfoundland and Labrador and Prince Edward Island, it would not be apparent from the graphs that there are more people in NL than in PEI.

Students should not be expected to convert raw data into percent data at this grade since calculation of percent is not in the curriculum until grade 7; however, they can be shown how to do so using technology if desired.

GCO F: Students will solve problems involving the collection, display and analysis of data.

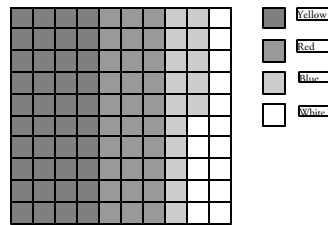
Worthwhile Tasks for Instruction and/or Assessment

Performance

F5.1 Ask students to research the percentage of people speaking various languages in a given province in Canada. Using *estimates* of the percentages, ask students to create a circle graph showing the distribution.

F5.2 Ask students to draw a circle graph that they predict will show the distribution of favourite type of music of classmates, if the classmates choose among country, rock, and classical. Then let them gather data, draw the actual circle graph and see how well they predicted.

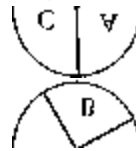
F5.3 Ask students to draw a circle graph to show the country of origin of baseball or hockey players from a favourite team.



F5.4 Ask students to convert the information on the hundredths charts to a circle graph.

Paper and Pencil

F5.5 Ask the student to estimate the percent for each segment of the graph. Ask: What might be the topic of the graph?



Interview

F5.6 Ask: Why do you think circle graphs are often used to show how a government is spending its budget?

F5.7 Ask the student to describe a situation in which a circle graph might be used instead of a bar graph.

F5.8 Ask whether or not the various sections of a particular circle graph can be 35%, 25%, 30%, and 15%? Explain.

Presentation

F5.9 Ask each student to obtain a circle graph from a media source and analyze the graph.

F5.10 Ask students to form in groups according to eye color. They should be arranged to make a “human circle graph”, with each section representing a particular eye color. The teacher, standing in the centre, can use string to show the divisions between sections. [Optional: The graph can be “captured” by taking a picture from a higher point.]

Suggested Resources

- Circle Mats
- Fraction Pieces

GCO F: Students will solve problems involving the collection, display and analysis of data.

KSCO: By the end of grade 6, students will have achieved the outcomes for entry-grade 3 and will also be expected to
 iii) *read, interpret, and make and modify predictions from displays of relevant data*

SCO: By the end of grade 6, students will be expected to

F6 interpret data represented in scatterplots

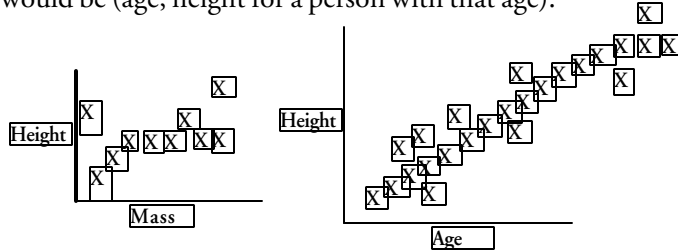
F7 make inferences from data displays including bar graphs, double bar graphs, and stem-and-leaf plots

Characterizing the shape of the data, as if you were going to sculpt this shape with clay, is a prerequisite to summarizing and theory building. Paying attention to the shape of the data may be the most important idea we can communicate to students about data analysis. When you look at a table or graph, what strikes you about the data? Where are the data clumped? Is there more than one clump? Are there bumps of data in surprising places? Are there holes that contain no data? (NCTM 1989 Yearbook, pp. 138-39)

Elaboration - Instructional Strategies/Suggestions

Note: Construction of scatterplots is not core at this grade level.

F6 Scatterplots are used to show the relationship between two quantities. The plot is made up of “scattered” points, which are ordered pairs. Each ordered pair tells the simultaneous value of the two quantities. For example, the plot might show the height for people of different masses. Each ordered pair would be (mass, height of a person with that mass). Or the plot might show height for people of different ages. Each ordered pair would be (age, height for a person with that age).

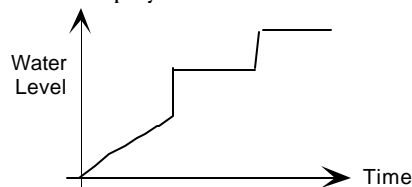


Other topics for scatterplots include

- temperature at different times of day (plotting hour against temperature) and
- tree height for different aged trees (plotting height against age).

Students should observe that fairly clear relationships are often shown (even though a few pieces of data may not fit the relationship well), and be able to describe these relationships.

F6 Note: Bar graphs, double bar graphs and stem-and-leaf were studied in Grades 4 and/or 5. Students are usually intrigued by unusual graphs. For example, the graph below displays the level of water as someone begins to take a bath.



In this type of situation, students should each tell a “story” about the graph, describing what each thinks happened to lead to the shape of the graph.

Students should also be drawing inferences from more conventional graphs and tables.

Note: Outcomes F5 and F6 may be integrated into other curriculum areas (e.g., science, social studies, physical education, etc.).

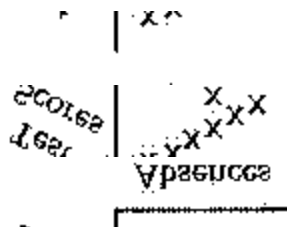
GCO F: Students will solve problems involving the collection, display and analysis of data.

Worthwhile Tasks for Instruction and/or Assessment

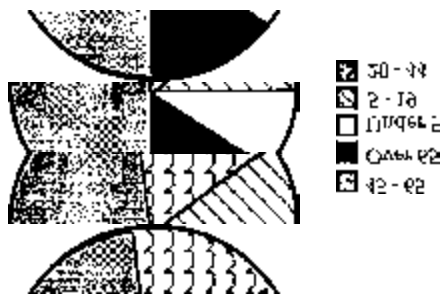
Suggested Resources

Paper and Pencil

F6.1 Ask: What conclusion might be drawn from this scatterplot?



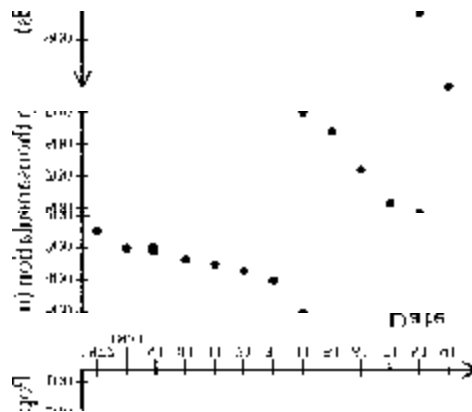
F7.1 Show this circle graph depicting ages of Canadians. Ask: What information can be gathered from the graph?



Interview

F6.2 Ask: How is a scatterplot like other graphs and how does it differ?

F6.3 Show a scatterplot of provincial populations in various years. Ask: What conclusions can be drawn?



Portfolio

F7.2 Ask students to collect a variety of graphs from the media and organize them by topic. Ask them to create a brief report on the information provided in the visuals.

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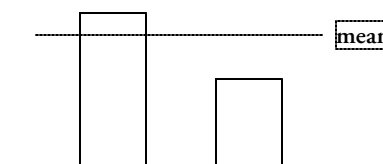
iv) develop and apply measures of central tendency (mean, median and mode)

SCO: By the end of grade 6, students will be expected to

F8 demonstrate an understanding of the difference between mean, median and mode

Elaboration - Instructional Strategies/Suggestions

F8 Students have previously encountered the concept of mean, i.e., the average calculated by taking the total amount and sharing it equally. They have also already seen that the total amount above the mean balances the total amount below.



The median is another type of average. It tells the middle number in a set of data once arranged in order. Students should recognize that the mean and median

| | | |
|--------------------|------------------------|----------------|
| - may be the same | 3, 4, 5 ↑ median | 4 ↑ mean |
| - may be different | 3, 4, 8 ↑ median | 5 ↑ mean |

The mode is yet another type of average, in some ways the easiest to determine. It is the piece of data that appears most often. For example, consider the following data: 5 5 5 5 10 3 3. The mode is 5 (which appears 4 times). In this case, the median is also 5, but the mean is not.

Note: sometimes, a set of data may have more than one mode. There is no mode when no data value occurs more than once.

Students should explore the “stability” of the mean and median. For example, ask them to compute both statistics for 3, 10, 15, 22, 45, and also for 3, 10, 15, 22, 100. They should see that an outlier (unusual piece of data) has much more impact on the mean than on the median or mode.

Students might find situations for which averages are described and try to decide whether it was a mean, median, or mode that was being reported in each case. For example, a baseball player’s batting average is a mean. If the average price of a house in a particular subdivision is reported, however, it might more likely be a median or a mode.

Note: Mode is often used for non-numerical data (e.g., most frequently occurring hair color in a group of people), or data from a population divided into categories (e.g., typical shoe size, typical number of children in a family).

GCO F: Students will solve problems involving the collection, display and analysis of data.

Worthwhile Tasks for Instruction and/or Assessment*Paper and Pencil*

F8.1 Ask students to create a set of 3 numbers for which the mean is a lot less than the median.

F8.2 Ask students to change just one piece of the following data to increase the median:

2, 3, 4, 5, 6.

F8.3 Ask students to create 2 different sets of data, each with a mode of 3, but one for which the mean is the same as the median and one for which it is not.

F8.4 Are the mean and median of this data the same? Explain your thinking. 30, 35, 37, 39, 49

Interview

F8.5 Ask students to identify situations for which the mean is usually greater than the median.

F8.6 Ask students for an example of a situation in which it might be difficult to determine a mode.

Journal

F8.7 Do you believe that the mean or the median is the most appropriate average to use to describe scores on a test? Explain why.

F8.8 An average amount of TV viewing time was reported as 20 hours a week. Which average do you think is being used? Explain your thinking.

F8.9 The following are John's grades in math for unit tests in term one:

60 65 70 70 95

When the average is reported to parents, do you think John would prefer it to be the mean, median, or mode? Justify your choice.

Suggested Resources

GCO F: Students will solve problems involving the collection, display and analysis of data.

KSCO: By the end of grade 6, students will have achieved the outcomes for entry-grade 3 and will also be expected to

v) *formulate and solve simple problems (both real-world and from other academic disciplines) that involve the collection, display and analysis of data and explain conclusions which may be drawn*

SCO: By the end of grade 6, students will be expected to

F9 explore relevant issues for which data collection assists in reaching conclusions

There are many opportunities to include statistics in the sixth-grade curriculum. In so doing, students review many mathematical ideas, relate mathematics to the real world, and extend their ideas about statistics. (Curriculum and Evaluation Standards, Addenda Series, Sixth-Grade Book, p. 16)

Elaboration - Instructional Strategies/Suggestions

F9 In particular, students should consider how and whether to interpolate or extrapolate from provided data.

Interpolating involves making predictions between existing pieces of data. Extrapolating involves extending beyond the presented data.

For example, suppose students have the following information taken from a survey in a school:

| Grade | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|----|----|----|----|----|----|----|
| Minutes spent on math homework (in minutes) | 10 | 30 | 30 | 60 | 60 | 60 | 80 |

Students might describe what the data tells us (that older students generally do more homework, but there is not necessarily an increase for each grade).

They might also consider whether they could use the data to determine what is an average amount of homework at grade 8 and what the dangers might be in extrapolating the average amount of homework in Grade Twelve.

Provide the following data:

| | | | | | |
|--|----|----|----|----|-----|
| Minutes spent on math homework per day | 10 | 30 | 60 | 90 | 120 |
| Score on math test | 50 | 70 | 85 | 90 | 91 |

Present the data in a scatterplot and ask students to predict a math test score for a student who does 20 minutes of homework per day. Ask the students to explain their reasoning.

GCO F: Students will solve problems involving the collection, display and analysis of data.

Worthwhile Tasks for Instruction and/or Assessment
Performance

F9.1 The following data describes the percentage of the population of Canada that was rural in different years:

| Year | 1961 | 1966 | 1971 | 1976 | 1981 | 1986 | 1991 |
|---------------|------|------|------|------|------|------|------|
| Percent rural | 30 | 26 | 24 | 25 | 24 | 24 | 23 |

Present the data in a scatterplot. Ask students to predict what the value was in 1996 and in 1982, and to comment on the reasonableness of their predictions.

Presentation

F9.2 Ask students to find an Internet site where data is displayed about the attendance at sports events for a particular team over a period of years. Ask the students to display the data. Ask: Could you use the information to predict the attendance in future years?

F9.3 Ask students to collect and display information about the change in the cost of postage stamps over the last 50 years. Then ask them to predict the cost to mail a letter in the year 2020, based on the data. Students should justify their predictions.

Project

F9.4 Groups of students should each select a question to which they would like an answer. They should then collect data and display their findings. Examples include:

- What is the level of physical exercise of eleven-year-olds in our province?
- In what ways does one school differ from another?
- What are the proportions of various problems that a local doctor or hospital treats?

Suggested Resources

