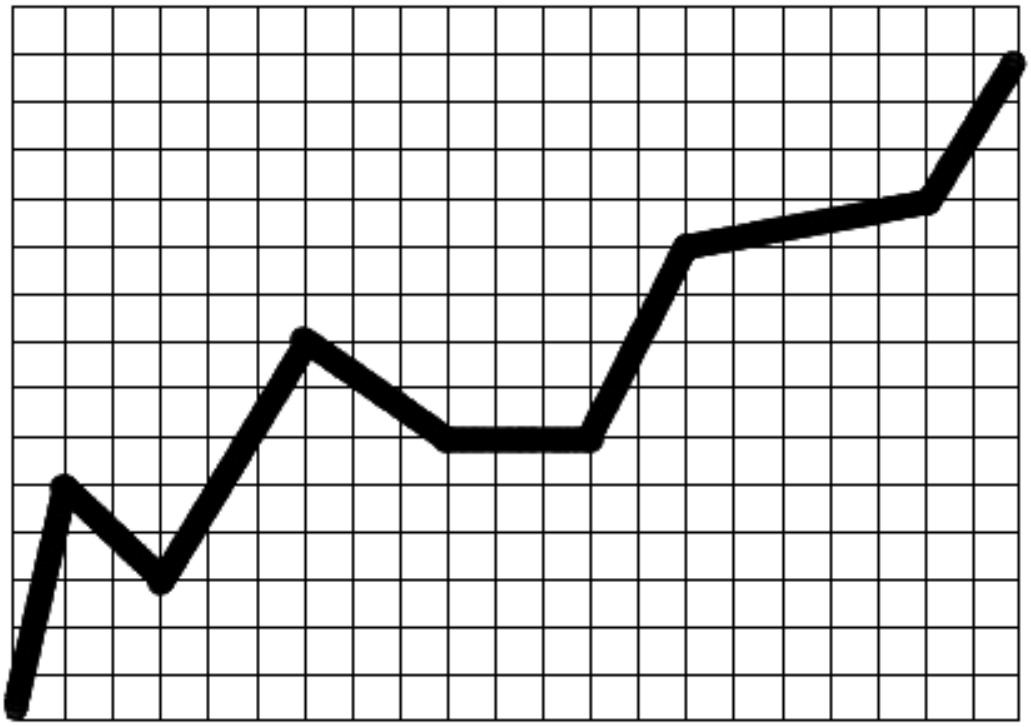
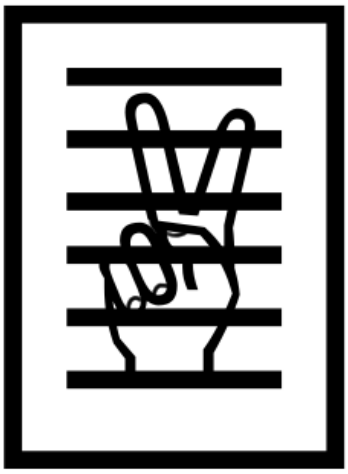
THE WEEKLY GRAPH



Intermediate and Middle School



Teaching Notes

THE WEEKLY GRAPH
- INTERMEDIATE AND MIDDLE SCHOOL -

The weekly graph introduces numeracy and mathematical relationships within contexts of meaning. It promotes student involvement, as it relates to real-life experience. The materials required for the weekly graph are simple. Teacher and students work together to choose an appropriate topic. As the graph takes shape, students attach small, magnetic-strip file cards alongside their items of choice. Students assume more ownership and demonstrate greater interest in developing graphs where they are permitted to name and design their own cards. You may also find it useful at times to color code boys' cards blue and girls' cards yellow or red, so that students can easily distinguish between them when reading graphs.

Graphing activities are based on the following essential principles:

- It is important that students are permitted to acquire content over a long period of time.
- Threat is reduced in the learning situation where students are awarded:
    1. Choice regarding time allotted to assigned activities.
    2. Choice regarding appropriate levels of challenge.
    3. Control over their own learning.
- Students need to make personal meaning of their learning and to be active in that learning.
- Threat is reduced in the learning situation where the learning process is modeled over time.
- The use of proper language when reading decimal fractions is crucial in helping students understand the relationship between fractions and percent.

Example: The Pizza I Like Best

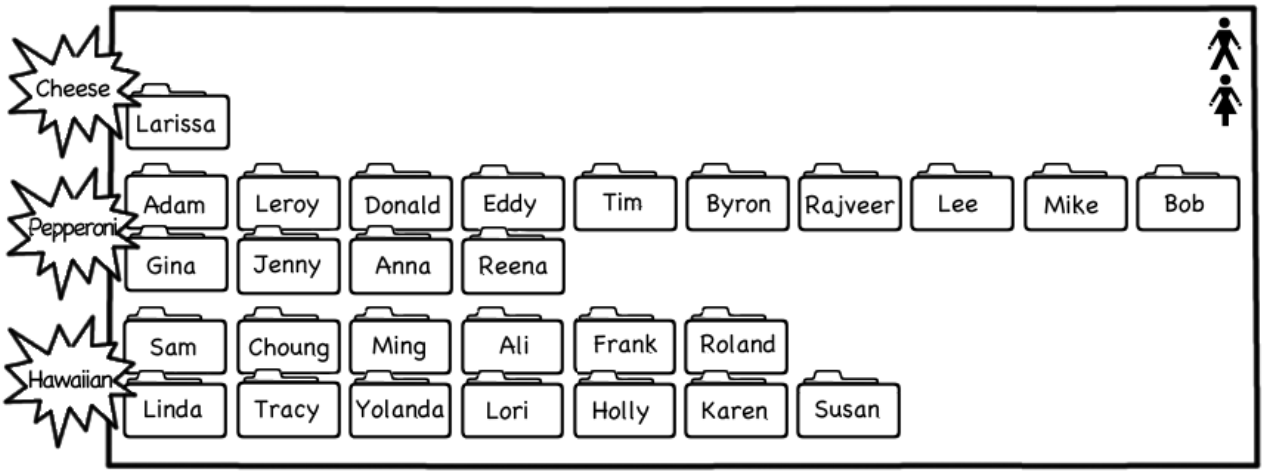
The following example illustrates how magnetized cards may be placed on the blackboard or whiteboard to create a double-bar graph showing the discrepancy in boys' and girls' responses. When you begin weekly graphing activities with your students, **avoid selecting the more popular graphing topics** (such as food, movies, and sports) yourself, in order that these topics remain available for student selection at a later date. Teachers often observe that students regard a graphing activity as a contest in which

only one item "wins". In order to avoid a misleading "win or lose" contest, many teachers find it more profitable to **ask questions that require a specific, numerical response**, such as: "How many pets do you have in your family?" rather than: "Which pet is your favourite?" The use of the word "favourite" seems to encourage students to regard the voting process as a competition.

My Favourite Pizza

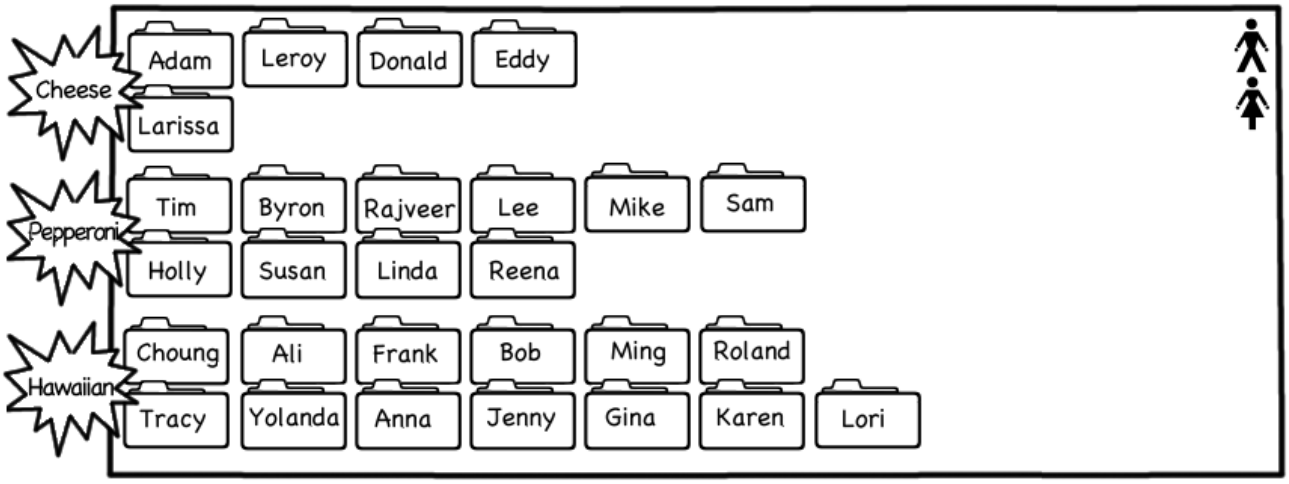
Cheese	Lesley	Megan						2	5	*G*
	Andrew	Morgan	Peter					3		*B*
Pepperoni	Lindy	Kirandee						2	9	*G*
	Gordie	Aaron	Josh	Dimitri	Marshall	Tomas	Zach	7		*B*
Hawaiian	Sara	Kala	Nikki					3	6	*G*
	Alex	Justin	Jamie					3		*B*
Vegetarian	Jesse	Jessica	Kirsten					3	4	*G*
	Jeevan							1		*B*

Life (and mathematical data) rarely "work" as planned, and many class graphs yield fractions that are both challenging and confusing. The following example (taken from a grade-seven class) illustrates what happens when only three categories are employed. The fractions yielded (**10/14** and **7/13**) are very difficult fractions to tackle at the beginning of a graphing unit. **You will find fifths are simple fractions to begin with.**



The example below yields less challenging fractions, as **1/5** of the students who like cheese pizza are girls, and **fifths are one of the easiest fractions to start with**. The advantage to focusing initially on fifths is that when **1/5** is entered into a calculator, the answer (**0.2**) does not suggest any misleading relationship between the **1**, the **5**, and **0.2**.

Students must learn processes of investigation when dealing with fractions and decimal fractions in order to understand the complexity of related patterns. Where the initial fraction of choice is tenths, students mistakenly assume that a pattern exists (**3/10** = **0.3**), when, in fact, none does.



Teaching Fractions as Percentages

- Teach the relationship of fractions to ratio by reviewing the graph (My Favourite Pizza) and referring initially to $\frac{2}{5}$ as in the example in this graph. Two-fifths works well and often reflects the ratio of boys to girls or girls to boys in a classroom. Ask two girls and three boys to stand at the front of the class. Emphasize with your students that two of the five people standing before the class are girls and develop the notation **2:5**.

My Favourite Pizza

Cheese	Lesley	Megan						2	5	*G*
	Andrew	Morgan	Peter					3		*B*
Pepperoni	Lindy	Kirandee						2	9	*G*
	Gordie	Aaron	Josh	Dimitri	Marshall	Tomas	Zach	7		*B*
Hawaiian	Sara	Kala	Nikki					3	6	*G*
	Alex	Justin	Jamie					3		*B*
Vegetarian	Jesse	Jessica	Kirsten					3	4	*G*
	Jeevan							1		*B*

Ask:

- ✓ What fraction of the people standing at the front of the class is made up of girls?
- ✓ What fraction of the people standing at the front of the class is made up of boys?
- ✓ What percent of the people at the front are girls? Are boys?

- Follow by asking two more girls and three more boys to come to the front. Have each new addition stand directly in front of a person of similar gender, so that two rows now stand before the class, each with three boys and two girls.

G G B B B
G G B B B

- **Ask**:
  - ✓ What fraction of the people in the **back** row is made up of girls? ($\frac{2}{5}$)
  - ✓ What fraction of the people in the **front** row is made up of girls? ($\frac{2}{5}$)
  - ✓ What fraction of all the people in **both** rows is made up of girls? ($\frac{4}{10}$)

- Follow by asking two more girls and three more boys to come to the front. Have each new addition stand directly in front of a person of similar gender, so that three rows now stand before the class, each with two girls and three boys. Repeat the questions listed above.

G G B B B
G G B B B
G G B B B

- Persist with this activity until you suspect that students may be beginning to lose interest.

- Examine the fractions developed so far with your students and encourage students to look for an inherent pattern. Persist until independent understanding occurs.

$\frac{2}{5}$ $\frac{4}{10}$ $\frac{6}{15}$ $\frac{8}{20}$ $\frac{10}{25}$

$\frac{3}{5}$ $\frac{6}{10}$ $\frac{9}{15}$ $\frac{12}{20}$ $\frac{15}{25}$

- Now have students shade **2/5** of one of the ***fifths squares*** found in the *Appendix*. Ask them to find the fraction button on the calculator – there isn't one so they might be quite shocked. Inform them that **2/5** means **2** divided by **5** and have them do the calculation on their calculator. Now have them "mouth the answer" using the technique described in the ***Tools*** section of this manual. Most students will say "zero point four or decimal four" depending on the age range of the class. Now ask them to put their heads on their desks because you want to conduct a vote and you don't want them influenced by the way others vote. When all heads are down, **ask them to raise their hand if they think "point four" is a fraction**. Most students will not raise their hand, even in grade eight, and it may be because they never say a decimal fraction as if it is a fraction. They leave out the "th" sound and the word "and" both of which send a signal to the brain that what follows is a fraction.

- To convince students the importance of saying **four tenths** have them stand and join you when they understand the pattern you will now show them. **Standing is always a good brain strategy** because it causes students to refocus attention, to make the memory kinesthetic and to change the pace. Begin by saying out loud, "twentieths, nineteenths, eighteenths,

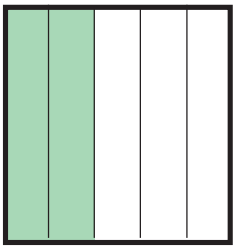
seventeenths...” and continuing. With luck most students will say “fiveths, fourths, threeths, and twoths” only one of which is actualy a word. **Make a note that most fractions end with a “th” sound.** In fact, only the common ones such as halves, thirds, and quarters do not. In other fractions this affects numbers like twenty-firsts and thirty-seconds.

- Now give students a ***tenths square*** (see the *Appendix* for fifths, tenths, hundredths squares and make sure you have overhead versions of the cut out squares) and have students fill in the same amount as they filled in on the ***fifths square***. In the early intermediate years almost all students only fill in two-tenths of the square and must be asked to compare the two squares to see if the same amount has been shaded in, rather than the same number of parts. **In order to get the same amount, more parts must be filled in because the parts are smaller.** Students should now have four-tenths shaded in. The teacher parallels the process on the overhead. Now try **4** divided by **10** on the calculator and the surprising result is **0.4** which now makes sense to say as “zero and four-tenths”.

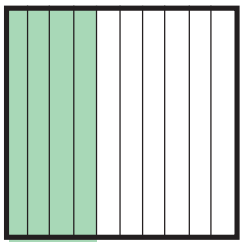
- The “and” part will become very important when saying mixed fractions like two *and* four-tenths which looks like **2.4**. Students taught this way learn to add **2.4** and **3.3** as two *and* four-tenths plus three *and* three-tenths by first adding the whole parts to get **5** and then adding the tenths parts to get **7** tenths for a total of five *and* seven-tenths. Students who use the words “point or decimal” often have to line up the numbers and write them down in order to arrive at an answer. **Saying numbers with meaning is important**.

We would never allow students to say **123** is one two three but we do allow them to say that **0.123** is “point one two three” rather than “zero and one hundred twenty-three thousandths.”

2/5



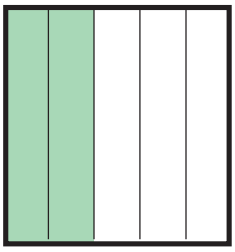
4/10



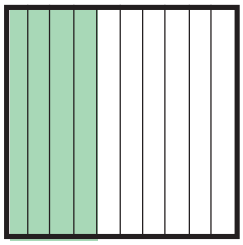
- Now give students a ***one-hundredths*** square from the *Appendix* and demonstrate the process on the overhead projector. Fold the hundredths square in half (on the overhead projector the teacher covers half). **Ask how many squares are in the top row** and when students indicate five on their fingers have them colour in two-fifths of the top row. This parallels the process of having two girls and three boys stand at the front of the classroom (which was done earlier). Now fill in two-fifths of the next row. This gives two-fifths in each row or four-tenths of the first two rows. Now do another row to obtain six-fiftheenths and try **6** ÷ **15** on the calculator. Repeat for **8** ÷ **20**. Students are often shocked to keep getting **0.4**. The calculator appears to think that all fractions are **0.4**. Continue the shading process to **20** ÷ **50** which is again **0.4**.

Turn to the unshaded half of the hundredths square and continue the process until all rows have two-fifths of the squares shaded in. Unfold the square to note that **40** ÷ **100** or **40**% is shaded.

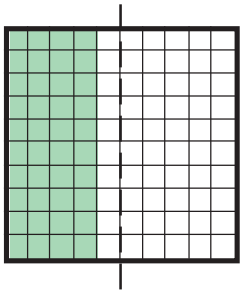
2/5



4/10



40/100



- Note how **40/100** can be transformed into **40%** by rewriting the **100** in the denominator. The "**1**" is written as a "/" and then the two zeros are strategically placed to give a "%" sign. Now record all of this on the ***Memorable Fractions*** sheet.

$$\frac{2}{5} = \frac{4}{10} = \frac{6}{15} = \frac{8}{20} = \frac{20}{50} = \frac{40}{100} = 0.4 = 40\%$$

- Now continue doing the other fractions that occurred in the ***Weekly Graph***. First, $\frac{3}{5}$ and then $\frac{1}{4}$ if you have time. Next, $\frac{3}{4}$ and with an advanced class move to $\frac{2}{9}$ and $\frac{7}{9}$.
  At this point it will be useful for teachers to have an overhead version of the thousandths square but students will never use this square because shading it in is too difficult.

- Teachers in grade four might consider doing the **Floor Hockey Problem** (#10) in the Grade 4/5 section of this manual before they do the first Weekly Graph. The problem is of interest to students this age and it guarantees that the fractions will start with $\frac{2}{5}$ and will not be repeating. Once the teacher decides to tackle repeating fractions it is worth reading the ***Fractions, Decimals and Percent Section*** of this manual and referencing the Fractions, Decimals and Percent Project in the ***Projects Section*** of this manual (it is the last project in the section).

- Follow by repeating the process described above using quarters (see Vegetarians in My Favourite Pizza).

$$\frac{1}{4} = \frac{2}{8} = \frac{3}{12} = \frac{10}{40} = \frac{20}{80} = \frac{25}{100} = 0.25 = 25\%$$

- You may find it effective to focus at some point on twentieths, as these fractions relate well to spelling test scores and can therefore be employed as a meaningful context for the study of percentages and decimal fractions.

- At some point follow up by connecting these fractions to the **Visual Percentage Calculator** in the ***Appendix***.

Follow-up Questions

Note*: *Teaching Notes (see below) are referenced throughout this chapter. Many teachers find it useful to place short references taken from the Teaching Notes section inside the margins of the main body of the text as they read along.

Initial graphing questions should always be relatively simple and concise, in order to build student confidence in the process. When asking questions in class, use the ***Every Student Response Technique***, in which the instructor waits until approximately half of all students show raised hands before he or she asks for a response. The teacher then asks individuals to "mouth" silent responses. In this way, all students feel that they have sufficient time to devise a response. The teacher, meanwhile, continues rewording each question until the majority of students have reached an answer.

- ✓ **Using your fingers, show me how many girls like cheese pizza. How many boys like cheese pizza? How many altogether?** *(Repeat these questions for each category.)*
- ✓ **How many students voted altogether? How were you able to figure out that answer? When you were figuring out your answer, did you use any "friendly numbers" (or numbers that add to 10)? Did anyone choose to add numbers in a different order than the order in which they are written?** *(See Teaching Notes.)*
- ✓ **How many more students like cheese pizza rather than vegetarian pizza?** *(Repeat this question for a variety of categories.)*
- ✓ **How many fewer students like Hawaiian pizza rather than pepperoni pizza?** *(Repeat this question for a variety of categories.)*
- ✓ **What fraction of students who voted for cheese pizza are girls? What fraction are boys?** *(Relate this question to the hundredths grid and be prepared to show equivalent ratios. Note, also, related comments found in the Teaching Notes section found below. Instruct students to enter these fractions on a **Memorable Fraction** sheet, which is found in the **Appendix**. Repeat this question for every category.)*
- ✓ **What percentage of students who voted for cheese are girls? What percentage are boys?** *(See Teaching Notes. Repeat these questions for every category.)*
- ✓ **What fraction of all students in the class likes cheese?** *(Repeat this question for each category. Note, also, related suggestions in Teaching Notes.)*
- ✓ **What percentage of all students in the class likes cheese?** *(Relate this question to the hundredths grid if you are teaching in Week Four or Week Five. Repeat this question for each category. Note, also, related Teaching Notes.)*
- ✓ **What is the mode?** *(The mode is the most popular category.)*
- ✓ **Is the mode different for boys than girls?** *(Note related Teaching Notes.)*
- ✓ **Do you think that if we surveyed another class at the same age level in a different school the results would be the same?** *(This is an excellent opportunity to discuss sampling with your students. Students are often astounded to discover that both different and similar grade levels in diverse parts of their city may express widely different tastes.)*
- ✓ **What does the graph tell you about your class? What did you learn from studying this graph?**

Teaching Notes for the Weekly Graph Section

The advantages to this unit are that students not only find the mathematical activities engaging, but they remain actively involved in the learning process throughout. This is particularly true where students assume responsibility for selecting both the graph topic and the related questions.

At the outset of the unit, avoid selecting the more popular topics yourself as the basis of demonstration lessons (such as favourite foods, colors, pets, music and so on). **Be sure to prepare a binder designed to hold all pertinent weekly graphing information and material.**

Students often view the voting process as a contest. Peer pressure often persuades students to vote with the prevailing majority, rather than to risk anticipated isolation by expressing their own individuality. Such voting processes render any survey or poll inaccurate and misleading. Although peer-pressure control may provide the basis for an interesting discussion topic in class, it yields little or no material of interest in the study of fractions and decimals in the graphing process. To counter unwelcome and often inevitable peer pressure, select topics that generate ***statements of fact*** rather than ***statements of preferred choice***.

Some examples are:

✓	How many television sets are in your home?	0	1	2	3 or more
✓	How many siblings do you have?	0	1	2	3 or more
✓	How many people live in your household?	2	3	4	5 or more
✓	How many pets live in your household?	0	1	2	3 or more
✓	How many movies did you attend over the summer?	0 or 1	2	3	4 or more

Week One

During the first week of graphing activities, focus upon demonstrating the concept of graphing, the questions commonly employed, and the use of the double bar graph. Be sure during this first week to demonstrate the use of the ***Memorable Fractions*** *sheet* (found in the ***Appendix*** of this manual), by recording the significant fractions that you and your students encounter in the questions you select. Teach an understanding of mode. Try initially to focus on fifths and quarters. If the questions posed do not yield fifths and quarters, create these fractions by posing graphing questions around small groups of students. **Fifths are particularly useful fractions to begin with**, as they are not as simple as tenths, and the relationship between the numbers shown in both the fraction and the related decimal are not immediately obvious. Use a calculator when finding decimals. Post an example of a double-bar graph, a circle graph, a single-bar graph, and the ***Memorable Fractions*** sheet on the bulletin board. The following week insert these items in the ***Weekly Graph Binder***.

Week Two

Using new data, repeat the activities listed in Week One, and have students transfer the information to a single-bar graph and then complete a ***Memorable Fractions*** *sheet*. Make note with your students of any fractions encountered during the previous week that appear in different format during Week Two (for example, **3/6** or **4/8**). Determine the mode. Display this information on a class bulletin board for a few days, before later placing this material in the ***Weekly Graph Binder***.

Week Three

Repeat the activities listed above, but omit the single-bar graph. Have the students transfer data collected in Week Three to a circle graph and then complete a related ***Memorable Fractions*** *sheet*. Note: Use the circle graphs provided in the ***Appendix*** or create your own circles if teaching a grade-seven class. Where total class voting equals factors of **360** (**18**, **20**, **24**, **30**), instruct students to calculate their own graph segments. Post graphs and the ***Memorable Fractions*** *sheet* on a class bulletin board for a few days before finally placing these items in the in the ***Weekly Graph Binder***.

Week Four

Have students transfer data collected in Week Four to a pictograph and then complete a related ***Memorable Fractions*** *sheet*. Inform students that you are looking for two volunteers who are willing to assume responsibility for planning and managing the weekly graph process during the following week, and that eventually each student in the class will have the opportunity to perform this task along with a partner. Explain that graphing responsibilities will include:

- Topic selection.
- Establishing appropriate questions.
- Creating a variety of graphs *(see Week Five).*
- Reviewing the final project and the evaluation criteria.
- Posting the graphs for a few days before placing them in the ***Weekly Graph Binder***.

Week Five

Ask for volunteers to assume responsibility for the graphing process. Allow students to work in groups of approximately two-to-five participants. Student are expected to:

- Create the question, and (depending on grade level), write the question on the blackboard.
- Create a single-bar or double-bar graph representing the data.
- Create a pictograph representing the data.
- Create a circle graph representing the data.
- Make a record of the fractions studied, including a picture of each significant fraction.
- Use the ***Memorable Fractions*** *sheet* to record the decimal and percentage equivalents of the fractions studied. (To the Teacher: See the ***Fractions and Decimal*** chapter of this manual for teaching tips and possible pitfalls to this activity.)
- Survey another class using the same topic and then compare the data. (To the Teacher: This is an optional activity, but it provides a rich source of meaning making.)
- Include all items in the ***Weekly Graph Binder***, after having ensured that each item has been posted on a class bulletin board for at least one week.
- Create a summary sheet outlining what was learned from the graphs created.

Topics and Connections:

- **Data analysis**: sampling, bar graphs, circle graphs, double-bar graphs, pictographs, mode
- **Problem solving**: making generalizations, predicting, reasoning, patterning
- **Communication**: using a display of data to advance an argument or thesis in a variety of ways
- **Numeracy**: adding, subtracting, dividing, regrouping, concepts of *more, fewer*, *altogether*, prime factors, factors, divisibility rules, fractions, decimal fractions, percentage, ratios
- **Geometry**: circles, degrees, the use of the protractor (where the class size equals 12, 15, 18, 20, 24, 30 or 36)
- **Technology**: use of the Internet in order to access information, use of spreadsheets for analyzing and creating graphs, use of a calculator

Brain and Learning Principles Emphasized:

- Learning is **active**.
- Learning is both a **social** and an **individual** process.
- Meaning making is found **through patterning**.
- **Emotions** are critical to the learning process.
  (Emotions are promoted through choice, control, and commitment.)
- The brain processes **parts** and **wholes** simultaneously.
- The natural **spatial memory** is accessed and developed through the use of graphing activities.
- **Processes** are learned in a context.
- Learning is enhanced by **challenge**.
- Learning involves both **focused attention** and **peripheral perception**.
- Learning involves both conscious and unconscious processes.
  (This is why bulletin-board displays and ***Weekly Graph Binder*** collections play a significant part in the learning process.)

Further Teaching Notes

- **"Friendly numbers" are numbers that add to 10**. In the example shown *(My Favourite Pizza)*, **6** + **4** are added to reach **10**, and then the **9** is added, yielding **19**. Then **1** is taken from the **5** to make **20**, so that finally we have **20** + **4** = **24**. In the first column, we see **7** + **3** and **3** + **3** + **3** + **1**, which yields **10** + **10**, and then **4** more equals **24**.

- Always ask for fractions as a **"ying and yang"** pair as in: **"What fraction are girls? What fraction are boys?** In this way, you will reinforce the "ying and yang" of fractions as part of a whole. Emphasize that the "ying and yang", or the two parts of the whole, equal one. For example: $\frac{3}{5}$ and $\frac{2}{5} = 1$

  $\frac{2}{9}$ and $\frac{7}{9} = 1$ and so on.

- When students are required to say, or pronounce, fractions that have larger denominators

  (as in $\frac{5}{24}$ of all students like cheese)

  they begin to learn the language of twenty-fourths, twenty-thirds, and so on.

- **Teaching an understanding of mode reinforces the significance of this term.** Avoid teaching an understanding of mode, median and mean in the same lesson, as this often creates long lasting confusion in students. Refer to the ***Fractions, Decimals and Percent*** chapter of this manual for further tips regarding the teaching of percentages using the hundredths grid and the visual calculator.

- **When first introducing students to the use of the calculator**, ask students to find the "fraction button". Of course, students will respond that no such button exists. Explain that the conversion of a fraction to a decimal (using a calculator) is best understood by using our knowledge of the relationship between fractions and division. For example: **8** ÷ **2** means **8** items divided into **2** groups, or **8** divided by **2**.

- Try the following fun and amusing activity when asking students to use a calculator when computing **1** divided by **5** (as in **1/5**). Students will respond that the answer is "**point 2**". Instruct students to "listen" to their calculators by placing their calculators up against their ears. Ask: "Can you hear anything? My calculator always pronounces fractions with a "th" sound at the end. Does your calculator do this?" This amusing game often helps students to say, or pronounce, decimal fractions with real meaning. If you always insist that fractions up to thousandths are pronounced with meaning, students will start to establish unconscious connections within the brain, and they will start to remember that **the "th" sound signals that a fraction is present.**

- Always teach students to say, or pronounce, any whole number that is part of a decimal fraction (as well as the fractional part) so that, for example, an entire fraction is read as "zero ***and*** one tenth". The "***and***" should be said with emphasis, as this will signal the brain that the part following the whole number is a fraction. This habit, once established, greatly assists students when they are asked to compute questions such as: **4** + **2.1**.

Students should be able to perform such operations mentally with ease. However, they are often unable to do so, because they "line up" the digits incorrectly. Students often assume that such questions cannot be performed mentally, as the decimals involved present insurmountable difficulties.

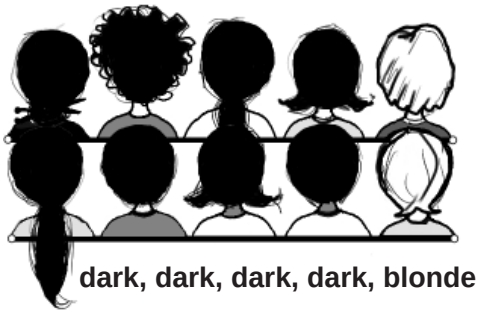
- When teaching fractions during the first four weeks of this unit, **focus initially on fractions that "work out" in a simple way.**
  - ✓ **Start with fifths if possible**, and then show equivalent fractions using tenths. Check findings on the calculator.
  - ✓ **Move to fourths and hundredths**. Whenever you are working with hundredths sheets, make the connection to percentage.
  - ✓ **Do not use the percent key on the calculator**, as the findings thus yielded will create the impression that a percent is a whole number.
  - ✓ Go back to fifths and tenths and make the connection between these fractions and hundredths. You will find this understanding easier to teach if you have already taught ratio. *(See the discussion that follows.)* Record all findings on a ***Memorable Fractions*** *sheet*. If the graph you are using does not yield any fifths, select a row or table of students that consists of five student members and base your fractions on this smaller group. Explain to your students that the fractions yielded in a whole-class graph may be too difficult or challenging to tackle initially. Instead, ask: "How many students in row one are wearing blue today?" Alternatively, ask: "What fraction of the class is girls (**2/5** or **3/5**)?" Use a similar strategy when you are teaching an understanding of fourths.

- **Reinforce the concept of ratios** by having students come to the front of the class and demonstrate ratios in the following way. For example, if **4/5** of all students who like cheese pizza have dark hair, and **1/5** have blonde hair, ask four dark haired and one blonde haired student come to the front of the classroom.

dark, dark, dark, dark, blonde

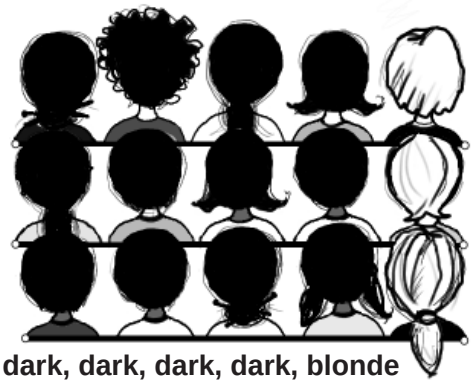
Step One: 1/5; 0.2 on a calculator; ratio 1:5

Now have four further dark and one blonde student come to the front of the classroom. Continue to repeat this visual process until full understanding occurs.



dark, dark, dark, dark, blonde

Step Two: 1/5 in each row; 2/10 in total; 0.2 on a calculator; ratio 2:10.



dark, dark, dark, dark, blonde

Step Three: 1/5 in the front, middle and back rows; 3/15 in total; 0.2 on a calculator; ratio 3:15.

- When teaching the use of the circle graph, use the grade-level appropriate circles found in the ***Appendix*** of this manual. Many teachers find it useful to enlarge the circles, so that each circle covers an entire page. Grade-seven students should learn to create the segments for their own circle graphs.

- Technology can provide an enormous support to younger intermediate students who are attempting to create circle graphs. Students enter the data into a spreadsheet program and then ask the program to create a circle graph or a bar graph.

- When teaching the use of the circle graph, you may find it useful to explore the prime factors and divisors of **360**, as this will help students determine segment sizes out of a possible total **360** degrees (**360** = **2** x **2** x **2** x **3** x **3** x **5**).
  - ✓ Circle graphs are easier to create where the number of students or categories is a divisor of **360**.
  - ✓ Ask students to cover up the factors of **360**. In our example, we see that **24** = **2** x **2** x **2** x **3**.
  - ✓ If students cover up **2** x **2** x **2** x **3**, they will be left with **3** x **5** = **15**. Therefore, each person in our sample is "worth" **15°** of a complete circle.
  - ✓ The *"cheese-lovers"* portion is therefore **5** x **15** = **75°**.
  - ✓ The *"pepperoni-lovers"* portion is therefore **9** x **15°** = **135°**.
  - ✓ The *"Hawaiian-lovers"* portion is therefore **6** x **15°** = **90°**.
  - ✓ The *"vegetarian-lovers"* portion is therefore **4** x **15°** = **60°**.
  - ✓ The total number of degrees is **75°** + **135°** + **90°** + **60°** = **360°**. Therefore, we know that our answers are correct, as the total sum equals **360°**.

- **You will find it very useful to relate fractions to a number line.** Ask students to draw a number line and to label the end points **0** and **1**. Then instruct students to place **2/5**, **3/4**, **7/8** and **1/4** along the number line. Ask how students know where to place each fraction. Where students are able to perform this task successfully, follow by asking students to draw a fresh number line and to label the endpoints **0** and **2**. Then ask students to place **7/5**, **7/4**, **7/8**, **2/3** and **5/4** along the new number line. You will also find it useful to write the fractions as mixed numerals, as in "one and two-fifths". The ***Daily Quiz*** will provide you with an excellent tool for teaching and reinforcing an understanding of fractions in the graphing process. *(See the **Tools** chapter of this manual for further information.)*

Connections of the Weekly Graph to Problem Solving

The weekly graph provides an excellent platform from which students may create their own problems. As the graphing data collected relates to student lives and experiences, the activities invariably engage and motivate students. Always insist that students show how a solution may be reached to any problem they created. Student-generated questions may be shared during a whole-class problem solving day, or during an assigned "Weekly Graph Day".

Addition problems are perhaps the easiest for students to construct. For example:

> In our class we are comparing student pizza choices. Four boys and three girls voted for cheese pizza. **How many students altogether voted for cheese pizza?**

> Seven students voted for cheese pizza, three voted for vegetarian pizza, five voted for meat-lovers pizza, and nine voted for Hawaiian pizza. **How many students voted in all?**

Graphing provides a particularly effective platform from which you may teach students how to write subtraction problems. For example:

- In our classroom, we want to create a graph that illustrates student fruit choices.
- How many more students like apples than like watermelons?
- How many fewer boys like apples than girls like apples?
- Nineteen students voted in all. Seven voted for apples. How many students did not vote for apples?

Fractions may also be emphasized in graphing activities with student-generated problems. For example:

- What fraction of students who voted for cherries were boys?
- What fraction of the whole class voted for cherries?

You may find it useful to make a copy of the different kinds of addition and subtraction questions suggested in the ***Appendix*** of this manual. In this way, you will ensure that many diverse questions are examined in class over the course of one month.

It is also essential **that students receive feedback regarding the correct use of mathematical terminology** in the writing of problems. You may find it useful to review mathematical terms on a class "word wall", with special reference to words like ***compare***, ***difference***, ***altogether***, ***more***, ***less*** and ***fraction***. It is also **essential that you review the use of criterion-referenced assessment before assigning the writing of problems**. Be sure to acknowledge the writer of each student-generated question as it is shared in class.

The Weekly Graph and Making Connections to: The Basic Facts, the "All the Facts You Need to Know" sheets and Games Day

Make connections to the ***"All the Facts You Need to Know"*** sheets whenever students create questions and write the related equations that answer those questions. In the previous example, where students are asked: **"How many students altogether?"** Some students will begin by adding **7** + **3**, thus paving the way to a connection with the "friendly facts". Ask students to circle all the questions on an "All the Facts" sheet that involve the "friendly facts" and to attempt only these questions initially. Depending on either the specifics of the graph studied, or on the strategies you wish to emphasize at any one time, make connections to the addition of nine and eight, and to the use of doubles when asking students to solve addition problems.

Subtraction problems based on graphing activities yield many mathematical connections. Encourage students to use the "cover up" method when subtracting, or to "break up" numbers in order to create easily manageable tens. For example:

> Three new students arrive in class, and the class now stands at **22** students. If seven students voted for apples, how many did not? (**22** – **7** = **22** – **2** – **5** = **15**) Therefore, **15** students did not vote for apples.

Make connections with graphing and basic facts activities to Games Day by playing ***Friendly Concentration*** whenever a student uses "tens" to add mentally.

Problem Solving and the Introduction of Initial, Simple Fractions

You may find it profitable to tackle a number of the problems suggested in the ***Problem Solving*** chapter of this manual before you choose to introduce weekly graphing activities. Problems that focus upon **2/5**, **5/20**, and **1/4** often promote understanding of fractions and decimals in a concrete, real-life context while providing sound groundwork for later graphing activities. Problem #10 in the grade 4/5 section of this manual relates to "Floor Hockey" and is an excellent introduction to decimals, fractions and percent for grade 4 and 5 students.

Note: ***Following a number of weeks of graphing activities, refer to activities found in the Fractions, Decimals and Percent chapter of this manual, as this chapter relates prime factors to terminating and repeating decimals. Also, consider doing the Fractions, Decimals and Percent project found at the end of the Project Section of this manual.***

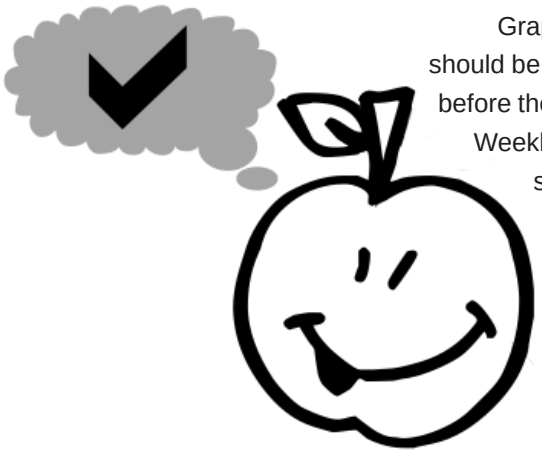
EVALUATION

Establish evaluative criteria with your students by using an adaptation of the standard format suggested in either the ***Appendix*** or the ***Evaluation*** chapter of this manual.

Include the following when establishing evaluative criteria:

- ✓ Graphs must communicate meaning, and therefore they must show clear and appropriate titles and legends.
- ✓ The use of color, underlining and illustrations very much enhance graphs.
- ✓ Neatness and presentation are essential to good graphing techniques.
- ✓ Accuracy in representing the data is fundamental to good graphing techniques.
- ✓ Accuracy in conversions from decimals to fractions is essential. Most decimals are rounded to the thousandths place, and percentages are rounded to the nearest whole number.
- ✓ A "What I Learned From this Graphing Activity" section is important, as this inclusion assists students to create personal memories and making meaning.

- ✓ Submitted material must include the following items in order to be considered complete:
  - A single-bar graph
  - A double-bar graph
  - A pictograph
  - A circle graph
  - A Memorable Fractions sheet
- ✓ Bonus marks may be earned for surveying another class.



Graphs created by each student group should be posted on a class bulletin board before they are finally placed in the class Weekly Graph Binder. Ensure that each student submits a self-evaluation along with all graphs.

TEACHING NOTES