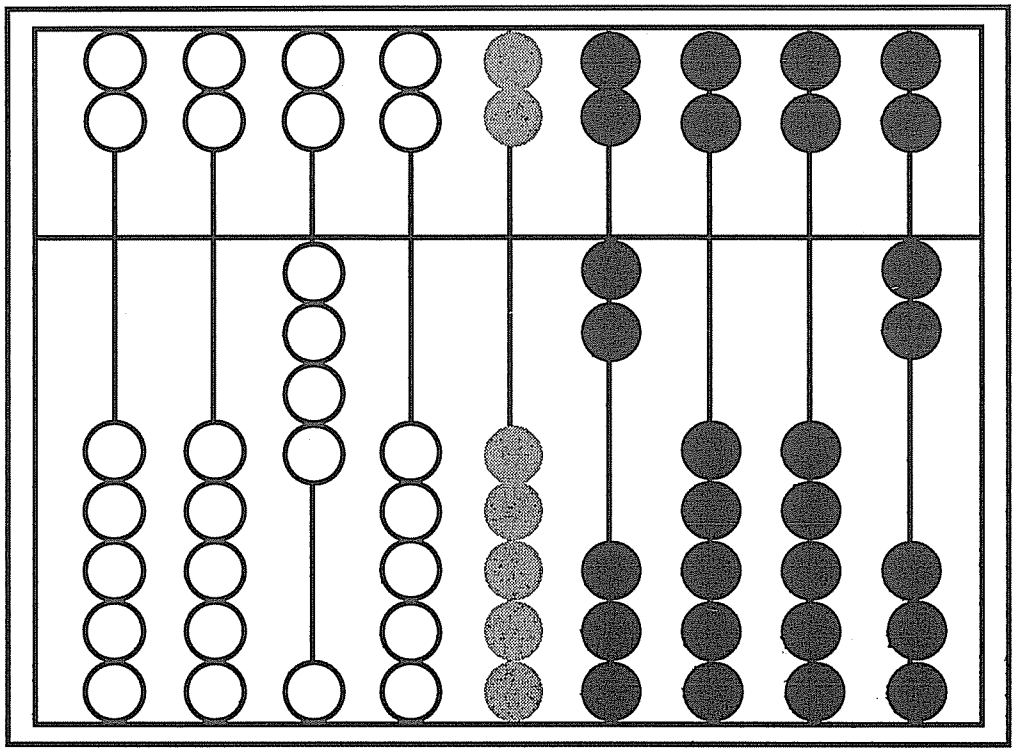
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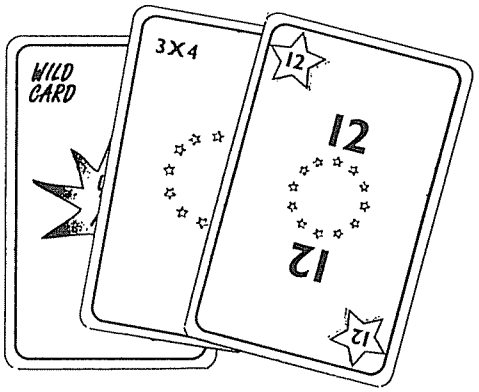
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▲ From the Editor's Desk

The theme of this issue is mathematics journal writing. *When students learn mathematics, they do more than master basic skills; they acquire a concise and powerful means of communication. Knowledge of mathematical language, structures, and operations will help students to reason, to justify their conclusions, and to express ideas clearly.* (Ontario Curriculum, Grades 1-8, 1997 page 5.) An overall expectation in the strands is that students justify in writing their thinking and inquiry processes in problem solving. At the annual OAME conference in May several speakers who presented journal writing ideas kindly shared workshop materials for readers of this issue.

Personally, I have used journal writing as a component of classroom participation in my night school adult classes and as a part of personal reflection/evaluation in self-directed study mathematics. My private senior elementary students have also benefited from journal writing. Journal writing is therapeutic for math anxious students; they are fearful about answering questions in class but are quite willing to express their frustrations with the subject if the journal responder is empathetic. I have recommended journal writing between child and parent. The child comes home from school and spends about fifteen minutes writing about the day. After the child goes to bed, the parent can take a few moments to write a response. The child awakes in the morning eager to see what parent wrote in the book. Most parents made the journal a habit on school days and reported to me that it was a great help staying in tune with school activities and their child's feelings about school. An added benefit was the great improvement in language writing skills that resulted. I hope you find the ideas of this issue's writers helpful to you.

Jennifer Torney and **Molly Larin** are instructional leaders in the mathematics department of the Toronto Catholic District School Board. **Sandra Folk** is a course instructor and program coordinator at the Ontario Institute for Studies in Education. **Cathy Marks Krpan** is also a course instructor and program coordinator at OISE/UT. She has taught in all elementary panels. Cathy has spoken across Canada and internationally on effective teaching and learning strategies. Her book "The Write Math" is available through Pearson Education. You can contact her at **cmarkskrpan@compuserve.com.** Thank you to all for your thoughtful contributions to journal writing.

Here are some interesting web bytes for this issue. **Mathematician's Birthday Calendar** lists famous mathematicians' birthdays by month and offers ideas for related lesson plans and I can see some interesting journal ideas in that one at **mathforum.org/~judyann/calendar**.

See **www.iknowthat.com**, click on Math and see the animated Leon the Chameleon movies, for ages 2-12. Students can practice basic computation as they use addition and subtraction to guide Leon through his adventures.

At **www.ceemast.csupomona.edu/amte/conference/1997/proceedings/liebars.html** there is an excellent article by Cathy Liebars about Journal Writing at the college level. Many of her ideas would be useful at the elementary and middle school level as well.

Frances Schatz

▲ Behind the Barrier: Teacher Notes

By Jennipher Torney and Molly Larin

This activity combines oral, visual, and written communication modes. It is best to present this activity over two or three class sessions. Depending upon their abilities, the students may need less or more time to fully explore this activity. This activity is suitable for grades three to eight. Of course, writing and drawing expectations will be modified depending upon student achievement levels, the grade and the intended curriculum.

1) Students decide who is going to be the builder of the design and who will be the copier of the design.
2) Students place a barrier between them using a file folder, binder, or textbook.
3) Using the manipulative of choice, the builder creates a design for the copier to duplicate. The game begins when the builder has completed a design.
4) The object of this game is to end up with two congruent designs.
5) The builder then describes the design step-by-step to the copier. The first time the students are playing this game allow the builder to peak periodically over the barrier to make sure that the instructions are clear. The copier is required to listen carefully to the directions given by the builder.
6) The copier is not allowed to look at the builder's original design.
7) Play is complete when the builder has finished describing the steps and the copier has finished writing and building. The pair is successful if the copier's design is identical to the builder's.

Once each student has had an opportunity to play each role at least twice, have the students pause in their exploration to discuss the type of words they needed to use in order to make themselves understood by partners. The teacher may also model the game in a whole class instruction highlighting appropriate math terms. Begin a list of directional words (e.g., behind, above, beside, diagonally, on top, left, right, underneath, etc.) on a piece of chart paper to left on display throughout this exploration. Allow the students to play each role once more and encourage them to use this language in their descriptions to their partners. Initiate a discussion by asking the students, "Which role they found most challenging, the builder or the copier?" Encourage students to explain their thinking.

The second session with this game will extend the student's use of language in describing their designs by having them record their designs using pictures and words. Have each student use a manipulative of one's choice to build his/her own design. Ask the students to record what it looks like on a piece of paper. Those students in Grade 6 who have chosen to use the interlocking cubes may need isometric dot paper for their drawing. Then ask each student to write the steps it took to create his/her design on the back of the paper. Remind them to read their instructions over to check for clarity of meaning. Collect the papers, mix them up, and distribute a paper to each student. The challenge this time is to follow the written instructions to build a copy of the original design. The student is successful if the design resembles the picture on the back. Remember that depending on the grade and the students' ability to draw the design, you may not have an exact copy of the picture. As long as it is a reasonably close replica the student has been successful.

Assessment Highlight:

After students have had multiple experiences playing Behind the Barrier and describing their designs in writing, an assessment task could be given. A Communication Rubric for Students and a Communication Rubric for Teachers has been provided for assessment purposes.

COMMUNICATION RUBRIC FOR STUDENTS

**Communication means using numbers, pictures, and/or words to explain your thinking and understanding of a topic or question.

Criteria	Level 1	Level 2	Level 3	Level 4
Communicating What I Know	I rarely share my thinking as I solve my problems.	I sometimes share my thinking as I solve my problems.	I usually share my thinking as I solve my problems.	I always share my thinking as I solve my problems when it is good to do so.
Using Mathematical Language	I rarely use mathematical vocabulary correctly when expected.	I sometimes use mathematical vocabulary correctly when expected.	I usually use mathematical vocabulary when expected.	I almost always use mathematical vocabulary correctly and can use these words in new situations
Using Mathematical Symbols, Labels, and Units	I rarely use mathematical symbols, labels, and units correctly.	I sometimes use mathematical symbols, labels, and units correctly.	I usually use mathematical symbols, labels, and units correctly.	I almost always use mathematical symbols labels, and units correctly and I know when to use them in new situations
Knowing when to use numbers, pictures and words.	My explanations only use numbers, or only use pictures, or only use words.	I use numbers, pictures and words but they don't connect together well to help my explanation.	I usually use a good combination of numbers, pictures and words in my explanation.	I almost always use numbers, pictures and words in a connected way that helps my explanation a lot.
Explaining Clearly	My explanations are difficult to understand.	I understand my explanations, but others find them difficult to understand.	My explanations are clear and understandable.	My explanations are clear, understandable, and very detailed.

COMMUNICATION RUBRIC FOR TEACHERS

Criteria	Level 1	Level 2	Level 3	Level 4
Ability to read and interpret mathematical language, charts, and graphs	Misinterprets a major part of the information, but carries on to make some otherwise reasonable statements.	Misinterprets part of the information, but carries on to make some otherwise reasonable statements.	Correctly interprets the information, and makes reasonable statements.	Correctly interprets the information, and makes insightful statements.
Correct use of mathematical symbols, labels, units, and conventions	Rarely uses mathematical symbols, labels, and conventions correctly.	Sometimes uses mathematical symbols, labels, and conventions correctly.	Usually uses mathematical symbols, labels and conventions correctly.	Consistently and meticulously uses mathematical symbols, labels, and conventions, recognizing novel opportunities for their use.
Appropriate use of mathematical vocabulary	Rarely uses mathematical vocabulary correctly when expected.	Sometimes uses mathematical vocabulary correctly when expected.	Usually uses mathematical vocabulary correctly when expected	Consistently uses mathematical vocabulary correctly, recognizing novel opportunities for its use.
Integration of narrative and mathematical forms of communication	Either mathematical or narrative form is present, but not both.	Both mathematical and narrative forms are present, but the forms are not integrated.	Both mathematical and narrative forms are present and integrated	A variety of mathematical forms and narrative are present, integrated and well chosen.
Degree of clarity in explanations and justifications in reporting	Explanations and justifications are unclear and imprecise.	Explanations and justifications are understandable to the student but would likely be unclear to others.	Explanations and justifications are clear for a range of audiences.	Explanations are particularly clear and detailed.

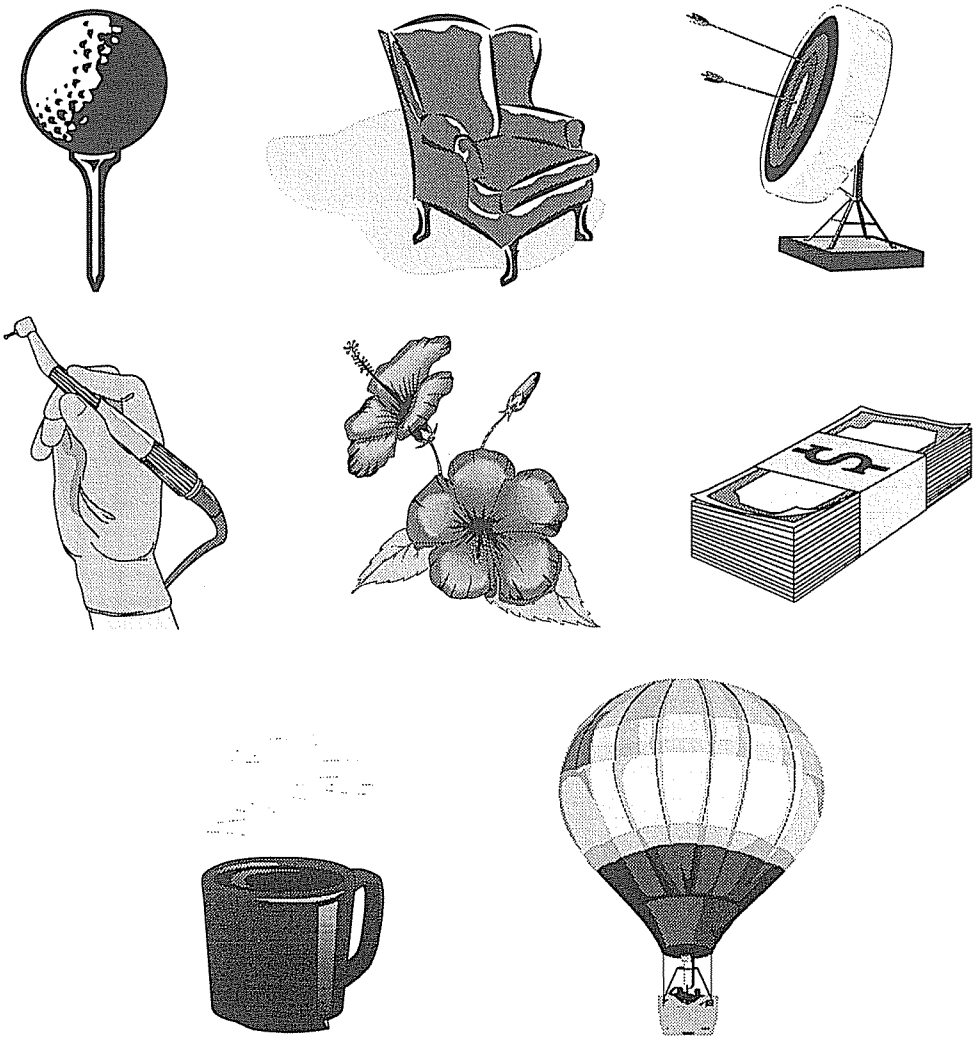
▲ The Write Math: Book Review

By Sandra Folk

In my experiences with mathematics education, I have found that having students write in math provides teachers with an opportunity to really find out and assess what students really understand about the concepts and ideas that have been taught. This aspect of learning is metacognitive in nature. Kathy Marks Krpan's book, *The Write Math*, presents teachers with some effective activities that could be used to have students engage in writing in math. They provide a more holistic way of assessing students' knowledge, than a quiz or test or answering an exercise that involves a set of questions, does. Some activities that really appealed to me, although they are all good, are Proving or Disproving Math Statements, and Ways to Integrate Discoveries in the Mathematics Classroom. In the first activity a student is given a statement such as, Decide whether 15+6= 35 (primary) or Prove or Disprove that 3/4= 9/12 and the student needs to write. In the second activity the students engage in and write about discoveries they make as part of investigations they carry out. Along with the other excellent writing activities there are good ideas for how to assess learning in math holistically.

I think that the book is a valuable resource for preparing students for EQAO testing that requires students to complete investigations to integrate math concepts and skills. Students need more practice with learning that is holistic rather than segmented into a shopping list of ideas, which the Ontario Math curriculum does. It is unrealistic to expect students to be successful on a test that is not well matched with the kind of learning that the curriculum promotes. Finally, I would say that the more opportunities with which we provide students to engage in activities that require thinking and reflection the better chance of developing understanding and improving success on tests such as EQAO.

Mathematics is like...



▲ Behind the Barrier Activity

Materials needed:

Barrier: File folders, textbooks, binders, etc.

Game Choices: Pattern Blocks, Interlocking Cubes, Geoboards with elastics, or Tangrams

Paper

Pencils, and coloured pencils or markers

Number of players: (2) builder and reporter

Object of the Game: To end up with two congruent designs one with manipulatives and one drawn on paper.

Game:

1. Decide who is going to be the builder of the design and who will be the copier (reporter) of the design.
2. Place a barrier between the players using a file folder, binder, or textbook.
3. Using the manipulative of choice, the builder creates a design for the copier to duplicate. The game begins when the builder has completed a design.
4. The builder then describes the design step-by-step to the copier. The reporter allows the builder to peak periodically over the barrier to make sure that the instructions are clear. The copier is required to listen carefully to the directions given by the builder.
5. The copier is not allowed to look at the builder's original design.
6. Play is complete when the builder has finished describing the steps and the copier has finished building. The pair is successful if the copier's design is identical to the builder's.

IDEAS TO CONSIDER

Pattern Blocks

Using Pattern Blocks students create a 2-dimensional design that has one or more than one line of symmetry. Through investigation explore and describe the size and the attributes of the design.

Interlocking Cubes Extension

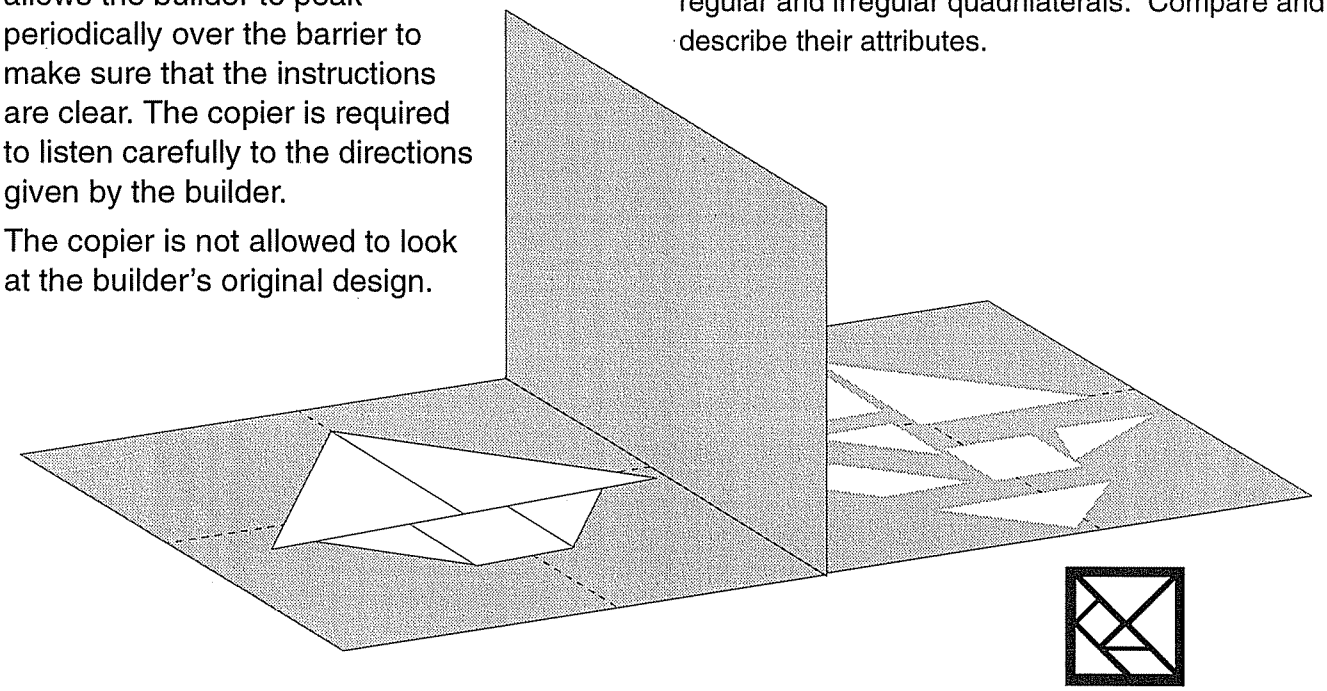
Using Interlocking Cubes students create, extend, draw, and describe a pattern.

Tangrams

Using Tangram Pieces students describe transformational geometry on a grid. (e.g., reflection of a parallelogram on a vertical axis)

Geoboards

Using Geoboards and elastics create a variety of regular and irregular quadrilaterals. Compare and describe their attributes.



▲ The Personal Side of Mathematics: Images, Reflections and Discussions

By Kathy Marks Krpan

Writing in mathematics can be a challenging task for students and teachers alike. For the most part, students often regard writing in mathematics as something unusual. They think, "Why should we write in mathematics? We already do that in language arts!" Yet educators know that writing in mathematics can provide them with wonderful insights about their students' thinking and their ability to reason and problem solve.

Writing in mathematics, just like writing in language arts, is a skill that needs to be developed. Students often read or listen to many stories before they begin to write their own. When students are invited to write about mathematics, they often do so in a vacuum. They do not have the abundance of examples or rich experiences with writing in mathematics that they do in language arts or in other curricula areas.

When educators first introduce writing in mathematics to their students, I often suggest that they begin with a topic that is not content laden. This allows students to become comfortable with the writing process without getting preoccupied with the correctness of the actual mathematical concepts. I also stress the importance of engaging students in talking about mathematics before they begin to write. This enables them to explore their own ideas and learn how others think mathematically. Talking about mathematics also provides students with an opportunity to edit and organize their thoughts before they write them down on paper.

One approach you can use to introduce writing in mathematics to your students involves sharing several different pictures on an overhead or on cards. (I use an overhead with images of a flower, a drill, a cup, archery set, an air balloon, money, a golf ball on a tee and an armchair – see page 5 for images). I try to incorporate as many diverse images as possible. After students have had a chance to view the images, invite them to think about which image best represents mathematics for them personally. Once they have had a chance to reflect on their choice, students share with a classmate the image they have chosen and the reasons for their choice. These mathematical discussions can assist students in embellishing their ideas. They can also help students become more cognitive of their own mathematical thinking.

The reasons behind students' selections can reveal many insights about their mathematical thinking. A grade 5 student explained that he thought mathematics was like an armchair because it was a very comfortable place for him to be. A grade 3 student wrote, "a flower is like mathematics because its petals are in a pattern. Gardens are like mathematics because they are put in straight rows." A grade 7 student chose the image of the golf ball on a tee. He was just beginning to learn to golf, and like mathematics, he found it meaningless and frustrating. When he successfully hit the ball, he had no idea what he did to get such a great shot. He wrote that in mathematics, when he answered a question correctly, he had no idea why it was correct. Reflections like these can provide teachers with a sense of how students feel about mathematics. Students' attitudes towards mathematics can have a great impact on their learning in the classroom.

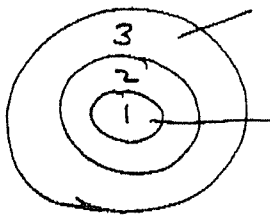
This activity can be done successfully with all grade levels and addresses the mathematical expectations in which students communicate their mathematical thinking. Once students

feel comfortable with this process, you can modify the activity to address specific expectations and introduce more content. For example, after completing a unit on probability, you can share a variety of images and invite your students to explain which one they believe bests represents probability. You can also request that they support their answers with the mathematical concepts they learned from their unit of study. Students can even debate why one image is more representative than another is.

Inviting students to share their personal thinking about mathematics using images as a focal point, can be an effective way to implement writing in the mathematics classroom. But more importantly, this process engages students in meaningful, personal discussions about mathematics that is paramount for a successful writing experience.

Here are two unedited samples. The hot chocolate sample is by a grade 2 student and the probability sample is by a grade 6 student.

I think probability is like archery The size of the target can change your chances. If it is small, you have a low probability of hitting it. If it is large, you have a better chance



high probability (large space)

low probability (small space)

There is a bigger target to hit

I think that math is lik hot chocolat becaus I like it. You need to mesur the water to make it and that math