Problems for the Web

P4W4: Folding Fun

Curriculum Areas: Symmetry, Spatial Sense, Problem solving

Introduction:

These activities all involve spatial abilities -- the ability to manipulate figures in one's head. The ability to visualize is a useful one in problem-solving. In order to give students practice in the use of mathematical language, you may wish to have students write descriptions of some of the figures formed by folding. Students could do this both before and after doing the folding, and then compare the details of the two descriptions. Students should check each prediction and then use the results to refine (if necessary) their predictions for the next problem.

Each activity can be given to student pairs or small groups to work through, or could be used as a whole-class activity.

For the Teacher:

P4W4 a): Folding Squares

Instruct students to draw a square, label it as shown and cut it out. (Display a square on the overhead or blackboard or chart paper.) Give students the first folding problem and have them discuss their mental pictures with a partner before sharing with the whole class. (Such discussions may involve the use of diagrams in place of words. For some students -- especially ESL -- this will be easier.) Then have them check by folding the square. Continue with other folding problems.

The questions included with problems 6 and 7 ("How can you find ...?") lead the student to notions of symmetry.

P4W4 b): Folding Rectangles

Since the rectangle does not have all the symmetries of the square, these results may be more difficult to picture. This is especially true of problem 6 -- folding on the diagonal. Many students think that the diagonal of a rectangle is a line of symmetry and that the figure should turn out to be a triangle. Actually folding the rectangle will prove that this is not so.

P4W4 c): Folding Circles

Some of these figures (for example, the figure produced in problem 4) will be more difficult to describe since they do not have specific names such as square, triangle, etc. Students may be surprised to discover that problem 3 leads to a semicircle. You might wish to ask them to find other folds that lead to semicircles. This will bring out the idea that a circle has an infinite number of lines of symmetry.

P4W4 d): Folding Parallelograms

Problems in P4W4 d) will be the most difficult to visualize since the parallelogram has no line of symmetry. Students may identify some of the resulting figures by the number of sides. For example, problem 1 gives a figure with 5 sides, a pentagon. Some students may also describe figures by properties such as parallel or perpendicular sides or types of angles (e.g. right or acute).

P4W4 e): A Challenge

If students have difficulty getting started on this problem, suggest they might begin with figures they know such as regular hexagons or octagons. An isosceles right-angled triangle such as is found in tangram pieces could also lead to some good problems.

Choosing a very complicated figure as a starting point could make the problems almost impossible to visualize or describe.

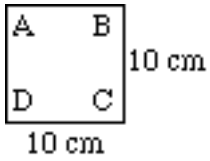
For the Students:

P4W4: Folding Fun

Work with a partner.

P4W4 a): Folding Squares

Draw a square that is 10 cm on each side.



Label the corners A, B, C, and D as shown. Cut the square out.

Imagine that you are folding the square in each of the following ways.

Do not actually fold the square.

Describe the result to your partner or draw a picture.

For example, if you fold A onto B you will get a rectangle that is half the size of the original square.

When you have decided what you think the results of the first problem below will be, fold the square to check. For each problem, predict the results: then check your prediction by folding the square

1. Fold A onto D.

2. Fold A onto B and then C onto B.

3. Fold A onto C.

4. Fold A onto D and then A onto C.

5. Fold C onto A and then D onto A.

6. Fold A onto the mid-point of side AB; then fold B onto the same mid-point.

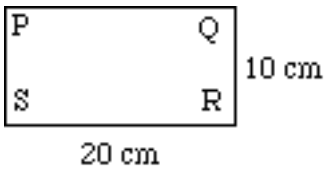
(How can you find the mid-point of side AB by folding?)

7. Fold A, B, C, and D onto the centre of the square.

(How can you find the centre of the square by folding?)

Did you find that some of the answers could be used to help picture other answers? Which ones? Why?

P4W4 b): Folding Rectangles



Now try mentally folding a rectangle.

Draw a rectangle with the given dimensions and label it as shown. Cut it out.

Describe or draw what you think the results will be.for each of the following problems.

Do not fold the rectangle yet.

Predict each result before folding the rectangle.

1. Fold P onto Q.

2. Fold R onto Q.

3. Fold P onto the mid-point of side SR.

4. Fold S onto the mid-point of side PQ; then fold R onto the same mid-point.

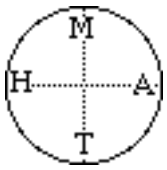
5. Fold P onto Q and then R onto Q.

6. Fold P onto R.

Which one was the easiest to picture? Which one was the hardest? Why?

P4W4 c): Folding Circles

Draw and cut out a circle. You can draw a circle by tracing around a cup or tin can.



Fold the circle in half and in half again.

Open the circle and label the ends of the fold lines as shown.

Picture the folds below and describe or draw the result of each problem.

Then check by folding the circle.

1. Fold M onto T.

2. Fold M onto T, and then H onto A.

3. Fold M onto H.

4. Fold M and T onto the centre of the circle.

(How do you know where the centre is?)

5. Fold M,A,T, and H onto the centre of the circle.

Did any of the results surprise you? Why or why not?

P4W4 d): Folding Parallelograms

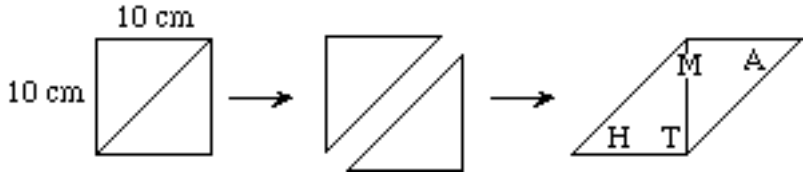
Draw and cut out a square that is 10 cm along each side.

Fold along a diagonal and cut.

Rearrange the pieces as shown and tape them together to form a parallelogram.

Label the corners M,A,T,H.

Picture the folds below and describe or draw them.



Then check by folding the parallelogram.

1. Fold H onto T.

2. Fold H onto T and then A onto M.

3. Fold H onto A.

4. Fold M onto T.

5. Fold A and H onto the centre of the parallelogram.

(How can you find the centre by folding?)

Did you find it easier or harder to picture folding a parallelogram than to picture folding a square? Why?

P4W4 e): A Challenge

Make up a folding problem with your partner. Write it on a card. Put answers on the back. Be sure to check your answers by folding. Trade problems with your classmates. Always try to picture the folds first.