Greeting Card Boxes

In this activity, members of your group make cool boxes out of old (or new) greeting cards or postcards. Before making boxes from greeting cards, people can practice making boxes from grid paper. In the process, they'll learn about area and volume, important concepts in middle school geometry. When you do this activity, every member of your group gets something nice to take home. The activity is also a great way to make use of used greeting cards.

Preparation and Materials

For this activity, you'll need one greeting card or two postcards for each person. (Forty postcards are in the Math Explorer Kit.) If you need more cards, you could ask people in your group to bring in cards from home. (Used cards are OK.) Cards must be rectangular; square cards will not work for this activity.

For each member of the group, you will also need:

- A metric ruler (twenty rulers are in the Math Explorer Kit)

- A pencil

- Photocopies of blackline masters

For each pair or small group to share, you will need:

- Scissors

- A calculator (ten are in the Math Explorer Kit)

- Clear tape (optional; five rolls are in the Math Explorer Kit)

Planning chart

Making a box from grid paper and exploring area and volume	25 minutes
Making a box from a greeting card or postcards	15 minutes

7

If you have time, make a box out of a greeting card before introducing this activity to your group. It will familiarize you with the process. Showing your completed box to the group is also a great way to encourage their participation.

Blackline Masters to Photocopy

Make one copy per person of:

- *Making a Greeting Card Box*
- *Greeting Card Box Data Sheet*
- *Grid Paper* (page 152)

Options

Making boxes from grid paper will help familiarize your group with the concepts of area and volume. This exploration will also give people a chance to practice making a box, which means that the boxes that they make from greeting cards will be much nicer.

Making a Greeting Card Box

Make a box from grid paper for practice—then make a
beautiful box from a greeting card.

What Do I Need?

◇ A sheet of centimeter (cm) grid paper

◇ A metric ruler

◇ A pencil

◇ Scissors

◇ A calculator

◇ A greeting card or two postcards that
   are the same size

What Do I Do?

Step 1 You are going to draw a rectangle that
has an area of 120 cm². The way to find the area
of a rectangle is to multiply the length times the
width. So you need two whole numbers that
make 120 when you multiply them together.
When you multiply centimeters by
centimeters, you get square centimeters
or cm².

   Figure out two numbers that you can multiply
together to get 120. These numbers will be the
length and width of your rectangle.

10 x 12

5 x 24

Both of these
rectangles
have the same
area: 120 square
centimeters

Step 2 Make sure that the rectangle you want to draw
will fit on your grid paper. If it won't, figure out two other
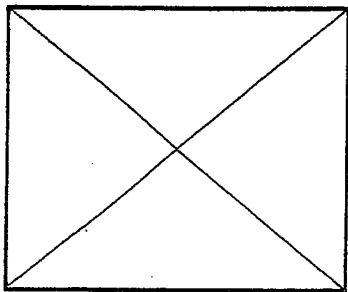numbers for your length and width.

9
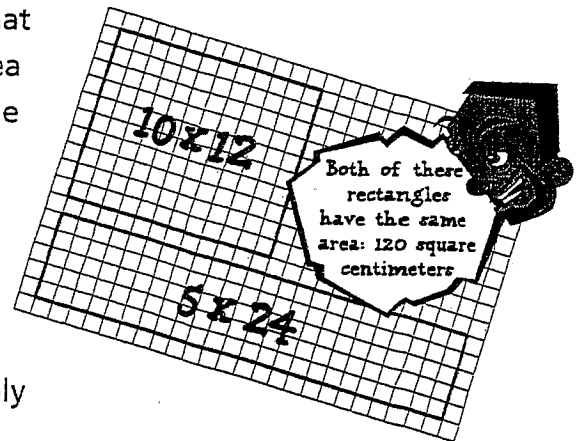
Step 3 Draw your rectangle on the grid paper. Use your ruler and use the grid lines to help you.

Step 4 Write the length, the width, and the area of your rectangle on your *Greeting Card Box Data Sheet*.

Step 5 Cut out your rectangle.

Step 6 Turn the rectangle over to the blank side. Draw both diagonals on the blank side of the rectangle.
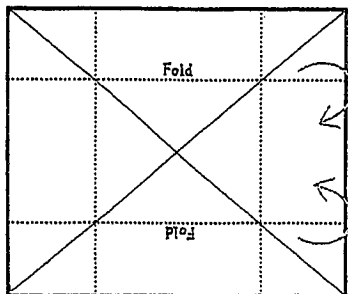
Step 7 The place where the diagonal lines cross is the center of your rectangle. Fold the sides of your rectangle in so that their edges meet in the center of the rectangle. Then unfold them.
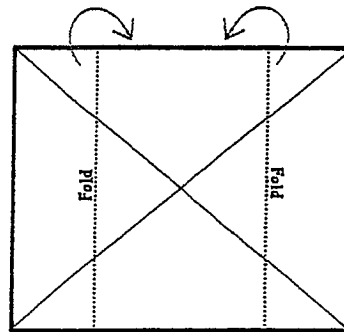
Step 8 Now fold the top and bottom sides of your rectangle so that their edges meet in the center. Then unfold them.

The folds on your card should now look something like this:

Step 9 Make four cuts into the rectangle, cutting into the sides that are shorter (the widths), and only cutting to the point where the fold and the diagonal meet.
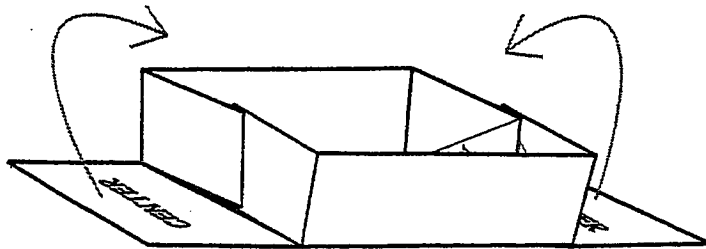
The Math Explorer/ © 2001 Exploratorium
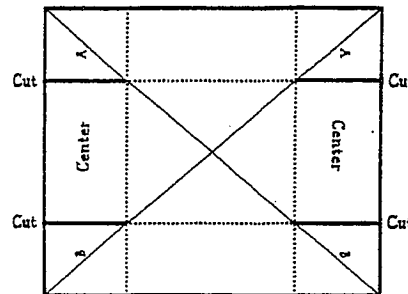
Step 10
Fold up flaps *A* and *B* at each end of your rectangle, leaving the center flap between them lying flat. Then fold in both sides so that flaps *A* and *B* meet or overlap.
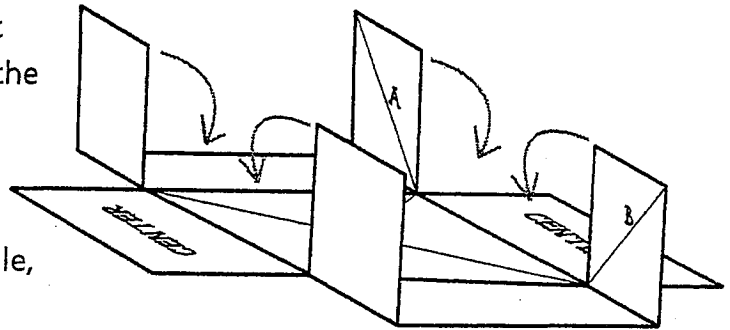
If you have a long, skinny rectangle, you may need to trim flaps *A* and *B* so they fit within the box sides you have just created.

Step 11
At each end, fold the center flap up and over flap *A* and flap *B*. The center flap will hold flap *A* and flap *B* in place.
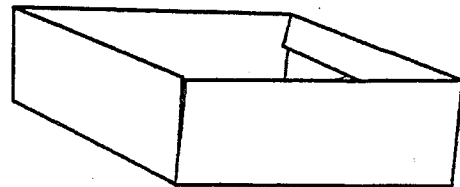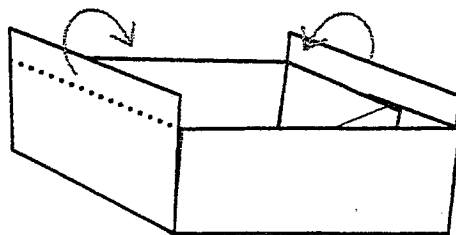
Step 12
Measure the length, width, and height of your box in centimeters and write your measurements on the first line of your *Greeting Card Box Data Sheet.*
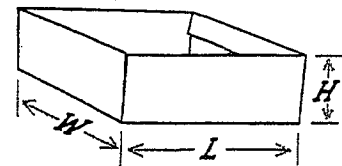
Step 13
The volume of this box is the amount of space it fills. You can calculate the volume of a box by multiplying its length times its width times its height. When you multiply centimeters by centimeters by centimeters, you get cubic centimeters or cm^3.

Calculate the volume of your box and write the volume on your *Greeting Card Box Data Sheet.*

**Step 14** Collect information on the boxes that other people in your group made and put it on your data sheet. Notice that everyone started with rectangles of the same area, but the boxes have different shapes and volumes.

Step 15 Now you're ready to make a greeting card or two postcards into a beautiful box.

If you are using a greeting card, cut it in half along the fold, making two rectangles that have the same area. The side of the card with a picture on it will become the box top, and the side of the card where you would write a message will become the box bottom.

If you are using postcards that are the same size, you do not need to cut them. One postcard will become the box top and one postcard will become the box bottom.
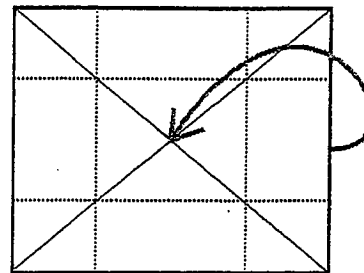
Step 16 Take the rectangle that has a picture on it and turn it over so you are looking at the back side. (It's okay if it has writing on it. Just ignore that.) Follow Steps 6 through 11 to make the box top.
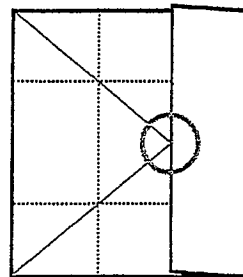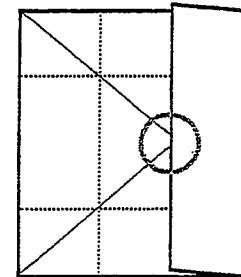
Step 17 Follow Steps 6 through 11 to make the box bottom from the other half of the card (or your other postcard). This time, fold the sides in a little beyond the center to make this box a little bit smaller than your first box. The box top should fit on the box bottom, making a box with a lid.

Box top   Box bottom
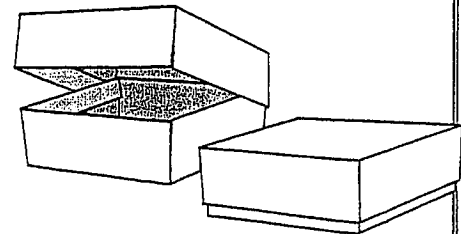
Step 18 Use your ruler to measure the length, the width, and the height of your box. Figure out its volume.

Explorer's Name: _____   Date: _____

Greeting Card Box Data Sheet

Use this data sheet to record information about your box
and the boxes that other people make.

Name of Box Maker	Length of Rectangle	Width of Rectangle	Area of Rectangle	Length of Box	Width of Box	Height of Box	Volume of Box
	cm	cm	cm^2	cm	cm	cm	cm^3
	cm	cm	cm^2	cm	cm	cm	cm^3
	cm	cm	cm^2	cm	cm	cm	cm^3
	cm	cm	cm^2	cm	cm	cm	cm^3
	cm	cm	cm^2	cm	cm	cm	cm^3
	cm	cm	cm^2	cm	cm	cm	cm^3
	cm	cm	cm^2	cm	cm	cm	cm^3
	cm	cm	cm^2	cm	cm	cm	cm^3
	cm	cm	cm^2	cm	cm	cm	cm^3
	cm	cm	cm^2	cm	cm	cm	cm^3
	cm	cm	cm^2	cm	cm	cm	cm^3
	cm	cm	cm^2	cm	cm	cm	cm^3
	cm	cm	cm^2	cm	cm	cm	cm^3

13

Helping Your Group with Greeting Card Boxes

This activity will give your group a chance to practice making measurements in the metric system. Making boxes and comparing the volumes of different boxes will also help people gain an understanding of area and volume, two important concepts in middle school mathematics.

Volume can be defined as the amount of space an object occupies. This can be difficult for people to visualize. Making these boxes transforms the abstract concept of volume into something concrete that people can get their hands on—and each member of the group ends up with a beautiful box to take home.

You can choose to have people do this activity on their own, following the directions on the blackline master, or you can lead your group through the process step by step.

Making Boxes from Grid Paper

If you made a box from a greeting card, show it to your group at the beginning of the activity. These boxes are so pretty that most people will want one to take home. You may want to emphasize that doing this activity with the grid paper is practice for making a box out of the nicer card stock.

Drawing a Rectangle (Steps 1, 2, & 3 of *Making a Greeting Card Box*) The first thing people have to do is figure out how to draw a rectangle that has an area of 120 cm^2. Because the area of a rectangle is the length of the rectangle multiplied by its width, they need two whole numbers that make 120 when multiplied together. For example, 20 × 6 = 120, so a rectangle that is 20 cm long and 6 cm wide will have an area of 120 square centimeters.

If you use photocopies of the grid paper on page 152 of this book, you'll find that four different rectangles will fit on the grid:

- 10 cm × 12 cm
- 8 cm × 15 cm
- 6 cm × 20 cm
- 5 cm × 24 cm

Encourage people to draw different rectangles, and remind them that everybody's rectangle will have the same area. Making a box from a rectangle that measures 5 cm × 24 cm is a little tricky. Make sure that whoever chooses to draw that rectangle is comfortable doing a little bit of monkeying around to make the box work.

Recording Data (Step 4 of *Making a Greeting Card Box*) Make sure people put the information about their own rectangle in the first line of the table on their *Greeting Card Box Data Sheet.*

14

Finding the Center of the Rectangle (Step 6 of *Making a Greeting Card Box*) Point out to your group that they can find the center of any rectangle by drawing diagonal lines connecting the corners of the rectangle. The intersection of the two diagonals of a rectangle will always locate the center of the rectangle.

Folding the Sides (Steps 7 & 8 of *Making a Greeting Card Box*) Show your group how to fold the sides into the center of the rectangle. Make sure that the edges of the card meet right at the intersection of the two diagonal lines.

Unfold the sides, then show your group how to fold the top and bottom edges of the rectangle into the center. Again, make sure that the edges of the card meet right at the intersection of the two diagonal lines.

Making the Cuts (Step 9 of *Making a Greeting Card Box*) Show your group where to make the four cuts into the rectangle. The cuts are always made into the sides that are shorter (the widths), and the cuts only go to the point where the folds and the diagonals meet. Some people may cut too far or cut into the wrong sides. If they do, they can fix their mistakes with clear tape.

Making the Box (Steps 10 & 11 of *Making a Greeting Card Box*) The pictures on *Making a Greeting Card Box* show how to do this, but some people may need your help. People who are making boxes from long skinny rectangles may have to trim flaps *A* and *B* to make them fit when the box is folded. The center flap may just barely fold over flaps *A* and *B*—or it may be long

enough to fold over the flaps and reinforce the floor of the box. You may have to help people make these adjustments and reassure them that there isn't just one "right way" to make a box.

Finding the Volume (Steps 12 & 13 of *Making a Greeting Card Box*) The volume of a box is its length times its width times its height. Have people measure their boxes in centimeters and record the measurements on their *Greeting Card Box Data Sheet*.

Some people may have trouble identifying the three different dimensions. For example, they will measure the length, the width, and then measure the length a second time, thinking it is the height. Remind people that, most of the time, they will get three different measurements.

To get the volume, each person must multiply the length times the width times the height. Tell them that this formula ($L \times W \times H$) tells us the amount of space the box fills in cubic centimeters. Have people record the volume of their boxes on their *Greeting Card Box Data Sheet*.

Comparing Volumes (Step 14 of *Making a Greeting Card Box*) Ask the people in your group to collect information on the area and volume of different boxes from their peers. As they collect this information from each other, they should write it on their *Greeting Card Box Data Sheet*.

When everyone is done, ask the group what they notice. Perhaps they will notice that the boxes have different shapes and volumes—even though everyone started with a rectangle of 120 cm^2. You may ask different people to hold up their boxes and share the area and volume they calculated.

15

Where's the Math?

This activity gives people the opportunity to make metric measurements and to use formulas to calculate area and volume. Volume is hard to visualize. It's usually defined in math class by a formula (length times width times height). Another way to talk about volume is to say that it's the amount of space an object occupies.

In the case of these greeting card boxes, the volume of each box is also a measurement of how much the box can hold (a concept that might be more familiar to your group). If these were wooden boxes with thick walls, the volume *of* the box and the volume *held* by the box might be different measurements, but with these thin-walled paper boxes, they are pretty close to the same.

In this activity, people measure length and width and height in centimeters. When they multiply length and width together to get area, their unit of measurement is square centimeters or cm^2. (The 2 in cm^2 is an **exponent**. For more on exponents, see page 93 or the *Glossary*.) When people multiply length times width times height to get volume, their unit of measurement is cubic centimeters or cm^3.

By asking everyone to use the same area for this exploration, people can see how volume changes when their rectangles' lengths and widths are different. The volume of a box doesn't depend only on the area of the original rectangle. It also depends on the rectangle's dimensions. Rectangles with lengths and widths that are nearly the same enclose larger volumes. Long, skinny rectangles (like 5 cm × 24 cm) enclose less volume than the boxes whose dimensions were closer together (like 10 cm × 12 cm).

Making Boxes from Greeting Cards or Postcards

Before you begin *Making a Greeting Card Box*, make sure you have enough cards (new or used) so that everyone has at least one greeting card or two postcards that are the same size. Remember: cards must be rectangular, not square.

Making the Top of the Box (Steps 15 & 16 of *Making a Greeting Card Box*) If your group is using greeting cards, people need to cut their greeting card in half by carefully cutting along the fold to create two rectangles that have the same area. Explain that the "front" side of the card will become the box top and the "back" side of the card will become the bottom of the box. If you are using postcards, you do not need to cut them: One postcard will become the box top and one postcard will become the box bottom.

16

Once people have rectangles to work with, they follow Steps 6 through 11 to make the top of the box. Be sure people draw their diagonal lines on the back side of the card, so that the pretty picture will be on the outside of the box.

Making the Bottom of the Box (Step 17 of *Making a Greeting Card Box***)** Making the bottom of the box is just the same as making the top of the box—with one small change. For the bottom to fit inside the top, it needs to be a tiny bit smaller than the top. To make a box that's smaller, just fold the sides a little

beyond the center on Steps 7 and 8. When the sides are folded up to make a box, the box will be a little bit shorter and a little less wide—but a little taller than the box top. It should fit neatly inside the box top.

Finding the Volume of the Box (Step 18 of *Making a Greeting Card Box***)** Have everyone find the volume of the box by multiplying its length times its width times its height. Ask different people to hold up their boxes and share the area and volume they calculated.

17