

## **Lab 13**

### **Geometry with paper folding**

Equipment: Color paper, ruler and cutter (optional)

The purpose of this lab is to construct simple polygons by paper folding. This is an inexpensive and practical way for the students to explore the properties of simple geometrical figures and learn a neat craft. Mathematics has connections with many different disciplines such as science, visual art, and music, hence it should not be taught as an isolated and abstract subject.

Since most objects are folded from a piece of square paper, the first step in this lab is to learn how to create a square from a rectangular piece of paper. Please read the instruction on the next page. You can tear off the extra flap along the crease if the crease is first sharpened by running a ruler along it. Please do not moist the crease because that will make the edge and corners blunt, and hence difficult for subsequent folding.

Your work is graded on the accuracy as well as completion, therefore you may have to practice several times before you can come up with your final product.

1. Cut out a rectangular piece of paper almost the same size as a dollar bill, and then follow the instructions on the 3<sup>rd</sup> page to fold a regular (equilateral) triangle.
2. Fold a regular pentagon from a square piece of paper.
3. Fold a regular hexagon from a square piece of paper.
4. (Bonus, 5 points) Fold a balloon.  
Please do not inflate the balloon when you hand it in. You are however, encouraged to fold another one and inflate it for practice.

**Note:**

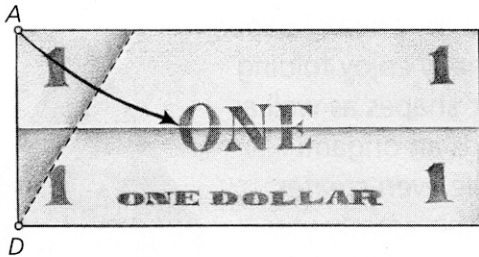
Please use the provided wax paper or any other good quality paper of the same size, and put all your finished products in a sandwich bag with your name printed on it, otherwise your work will not be graded.

## Folding an Equilateral Triangle

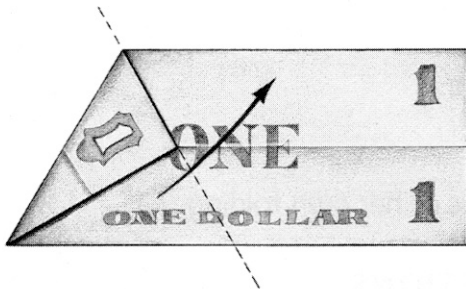
- 1** Fold the dollar bill in half lengthwise and unfold.



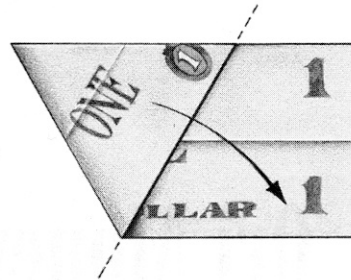
- 2** Fold the top left-hand corner down so that point *A* is on the crease. The fold must also go through point *D*.



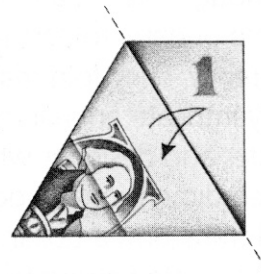
- 3** Use one edge of the triangle you just made as your new fold line.



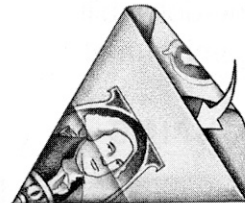
- 4** Use the edge of the triangle as your next fold line.



- 5** Use the edge of the new triangle as your next fold line.



- 6** Unfold the last fold. Tuck the flap into the pocket.

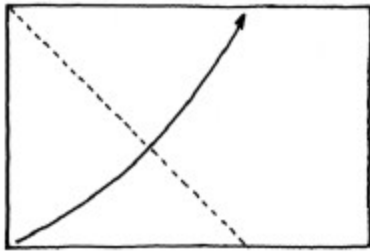


- 7** The completed piece looks like this.



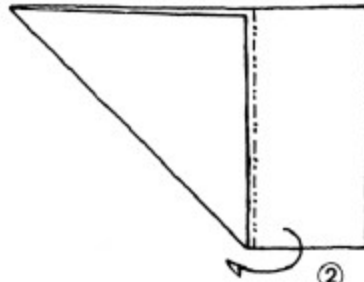
Name: \_\_\_\_\_

### Create a square from a rectangular piece of paper.



Fold up along the dashed line.

①



Fold the flap backwards along dashed line

②

Unfold  
You'll have a square

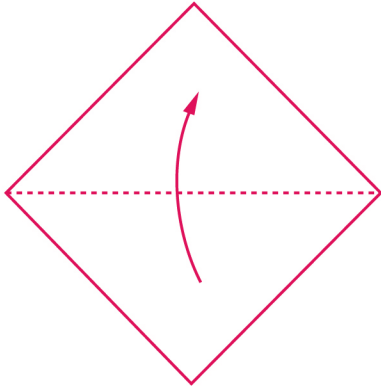


Cut along crease.

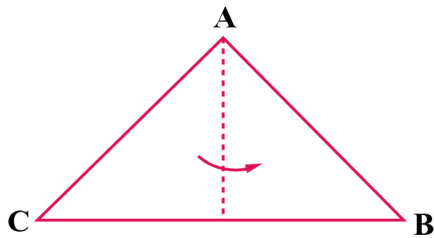
Knife

# Folding a Regular Pentagon

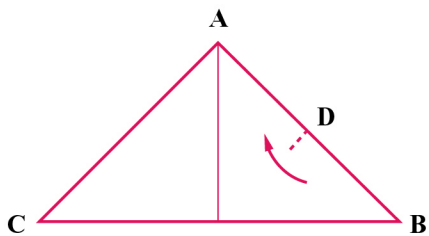
- 1 Fold along the diagonal.



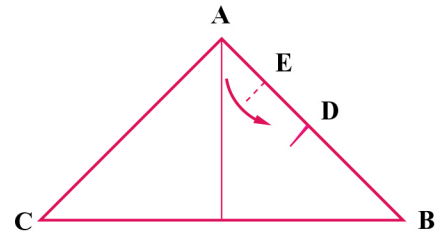
- 2 Fold along the dashed line so that C lies on B, form a crease and then unfold.



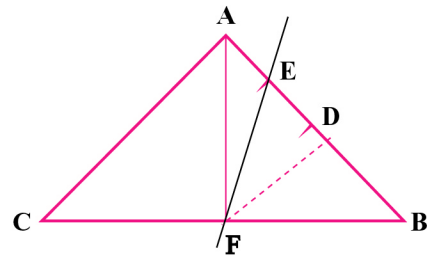
- 3 Fold corner B upward to meet point A and mark the midpoint D with a short crease.



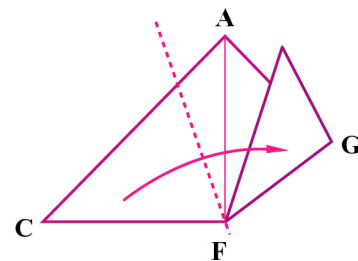
- 4 Fold corner A down to meet point D and mark the midpoint E with another short crease.



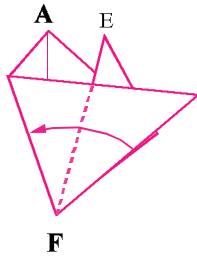
- 5 Fold corner B upward along the dashed line so that FB lies on FE. (The result should look like the diagram in 6.)



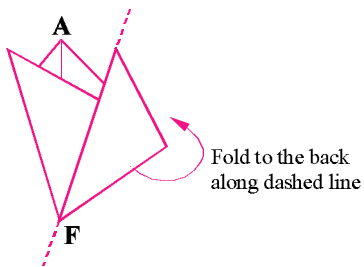
- 6 Fold corner C upward along the dashed line so that CF coincides FG.



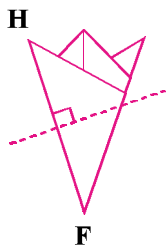
7 Fold the top flap back along EF



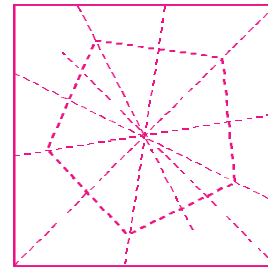
8 Fold all layers on the right side back along EF



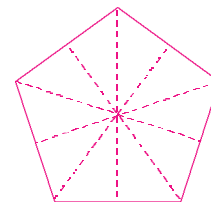
9 Fold all layers along the dashed line so that H meets F.



10 Unfold completely and open the paper, you should see the outline of a regular pentagon.

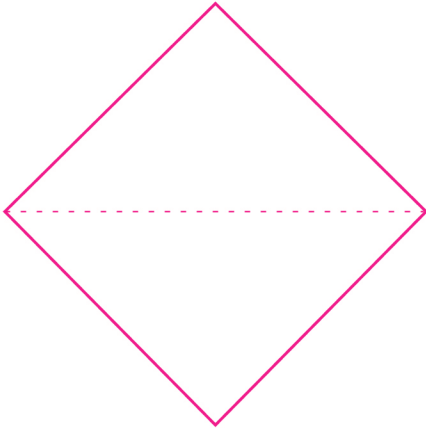


11 Fold along the outline of the above pentagon until you get an actual pentagon as shown below.

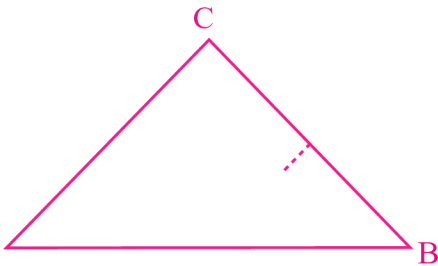


## Folding a Regular Hexagon

- 1 Fold the square in half along the dashed diagonal.

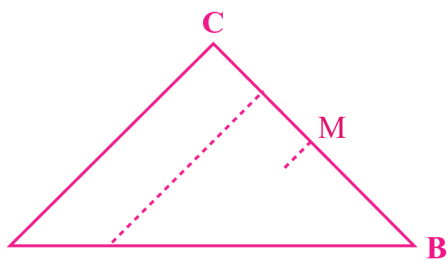


- 2 Fold the corner B up to meet point C and then make a short crease (dashed line) to mark the midpoint of side BC.

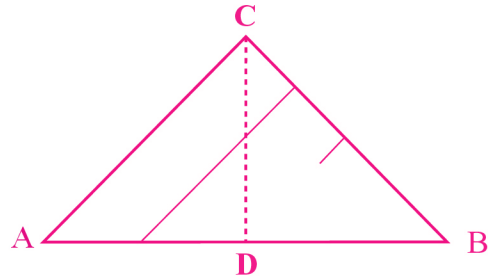


After unfolding, you should see a clear marking of the midpoint M.

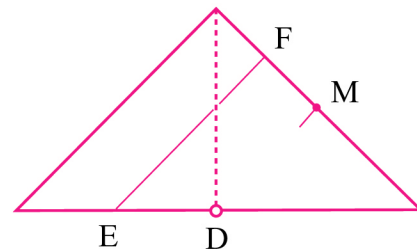
- 3 Fold the triangle so that point C meets point M and form a crease along the long dashed line. Now unfold.



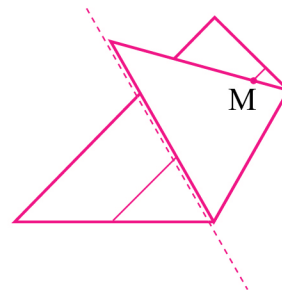
- 4 Fold the triangle so that point A meets point B and form a crease along CD. Unfold afterwards.



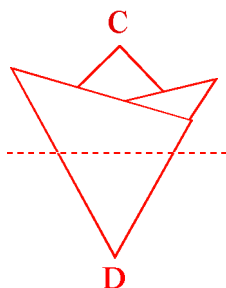
- 5 Use the nail of your left thumb to hold the point D fixed and then fold the lower right corner of the triangle up pivot about point D so that M lies on the line EF. The result should look like the picture 6.



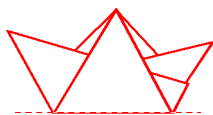
- 6 Fold the the lower left corner up along the dashed line.



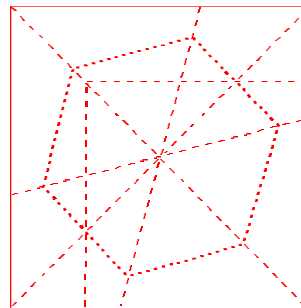
7 Fold the bottom half up along the dashed line so that C meets D.



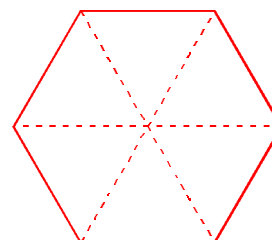
8 After step 7, your paper should look like the diagram below. Unfold your paper completely and you should see the creases similar to that in the next diagram.



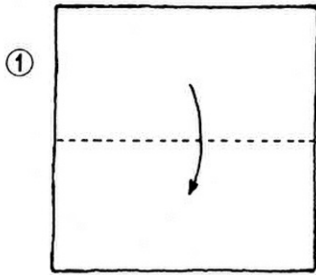
9 You should see the creases of a regular hexagon. Fold along those creases to form a real regular hexagon.



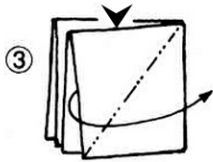
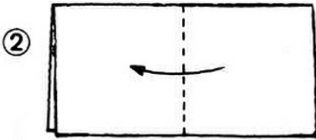
10 Finished product.



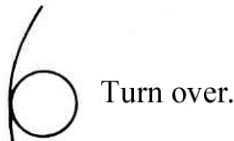
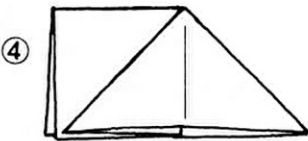
# Balloon and water bomb



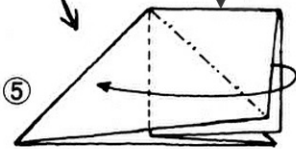
① Fold the square in half.



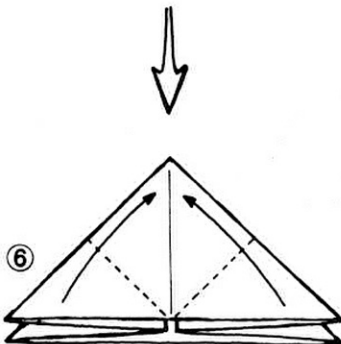
③ Squash down and open up to the right



Turn over.

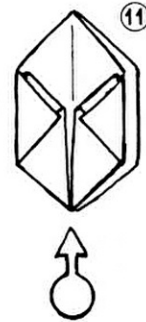


⑤ Squash again.



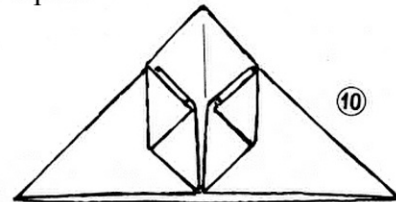
⑥ This is the Water-bomb Base.

The balloon is also called "Water-bomb" because it will hold water. You must fill it very carefully, with a little funnel or medical dropper.



Hold very loosely, with locks top and bottom (not as sides) and blow hard here.

One side is done. Turn over and repeat steps 6 - 9.



Roll the points down and into the pockets. This is called the "Water-bomb Lock".

