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Paper and Paper Folding



- Paper is a thin mat of plant fibres
- Papermaking knowledge spread from China where it was invented
- There are many traditions of paper folding around the world



Around the World



- In France, it is known as faire les cocottes
- In Spain, it is papiroflexia or pajaritas
- In Japan, origami means "fold paper"



Four Kinds of Origami



Origami can be classified as:

- Ceremonial such as cut and folded paper streamers in temples and for use in rituals
- Practical for example envelopes and containers
- Play "chatterboxes" for example
- Creative origami as an artistic and educational activity



Which kind of origami are these?



Images, clockwise from top L: <u>Umamanualidades</u>, <u>CC BY-SA 4.0</u>; <u>Papierflieger -- 2021 -- 7215</u> by <u>Dietmar Rabich</u>, <u>CC BY-SA 4.0</u>; Tung Ken Lam; <u>praaeew</u>, public domain

Origami in Japan



At shrines and temples in Japan you will see:



Zig-zag paper streamers attached to important objects





Paper fortunes which have been tied up and left behind

Origami in Japan



Elsewhere in Japan, you might see:

- Decorative kusudama
- Shops specialising in paper and origami
- Paper cranes which are a symbol of peace and good luck



Origami & Mathematics



- Mathematics arises naturally from origami
- For example, folding one point onto another point makes a straight line crease
- Folding a paper triangle can demonstrate that the angle sum is 180° and how to calculate the area of the original triangle









Origami and STEM



- Scientists, engineers and mathematicians research origami
- Origami has helped design useful items which can be folded up small when they are not being used
- Two examples are airbags in cars and collapsible kayaks, but there are many more.





Airbag image by <u>jimmyyyy</u> is licensed under <u>CC BY-NC 2.0</u>; Oru Kayak image by <u>Lindblom</u> is licensed under <u>CC BY 2.0</u>;

Task 1: Paper Cup



- This simple origami model is fun and practical!
- Made from small paper, it can be used for holding liquids
- Made from larger paper, it can be worn as a hat



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Tips for folding



- Be accurate and make sharp creases
- Use a clean and flat surface for support during folding
- Fold the diagonal of a square by placing the bottom corner onto the top corner. Hold the corners together with one hand and sweep the paper flat with the other hand. Use a fingernail or thumbnail to make a firm crease.



Diagrams by Tung Ken Lam of folding the diagonal of a square: extract from "Star Origami" by Tung Ken Lam, A K Peters/CRC Press, 2021

Task 1: Paper Cup



1. Fold the bottom corner to the top corner to fold the diagonal.

- 2. Move the right corner onto the left edge of the triangle. Adjust the position so that top edge of the flap is parallel to the hypotenuse of the original triangle.
- 3. Fold the left corner onto the right corner.

4. Fold the top upper flap downwards.

5. Turn over and repeat step 4. Then open the cup with your



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Task 1: Paper Cup



Now unfold the cup and observe the crease lines.

- Which line segments are equal?
- What angles can you identify?



Task 2: Fractions



- Now we're going to use origami to look at fractions.
- All you need is a rectangle of paper (not a square)!
- Can you remember the tips for folding? This time, you will start by folding the bottom edge of your paper up to meet the top edge.



Diagrams by Tung Ken Lam of folding a square in half (book fold): extract from "Modular Origami" by Tung Ken Lam, Schiffer Books, 2023

Task 2: Fractions



- 1. Fold the long edges together to fold the paper in half. Unfold.
- 2. Fold each of the long edges to the middle. Unfold.
- 3. Fold the short edges together to fold the paper in half. Unfold.
- 4. Fold the short edges to the middle. Unfold.



Task 2: Fractions



- With this 4 by 4 grid, what fractions can you make if the whole rectangle is one unit?
- What are the equivalent fractions?
- What operations can you perform on these fractions, e.g. add, subtract, multiply and divide?

Task 2: Magazine Box



- Now take your 4 by 4 grid and fold the short sides to the middle. Make the magazine box by following the steps below.
- If you make two, you can fit them together as a box with a





- This origami is also practical
- It can be used for storing seeds or other small items, or you could write a letter to a friend and fold it up!
- You will need a rectangle of paper.





1.Fold the long edges together and unfold. Fold the sides into the centre and unfold the left flap (the right flap stays folded).

2. Lift the bottom right corner and fold it onto the middle line of the original rectangle. As you do so, make sure the fold starts at the point which is one quarter along the bottom of the original rectangle.





3. The red point indicated will be the centre of the hexagon. Fold the lowest right corner onto this point.

4. Fold the left flap into the middle so the two points indicated on the diagram touch.

5. Fold the top flap down so that one point on its left edge meets the centre of the hexagon and another point meets the lower right vertex.



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6. Fold the upper flap in half. (The crease line is the middle of the original rectangle).

- 7. Fold the flap to the left.
- 8. Tuck the flap into the pocket that is behind the flap.



Extension Activity 1



• The second fold of the paper cup has a precise location point: it is the intersection of the left edge of the triangle and the angle bisector of the right corner. Why?



Extension Activity 2



• For each model, make another one without looking at the instructions. Use the first model to help you remember the steps, or work out what is needed.









This resource was designed by Tung Ken Lam in collaboration with the Japan Society

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