Folding Fantasy
Appendix

PBSOrigami

DIFFICULTY

While I do my very best to make each book accessible for those who will want to give it a go, no amount of clarity will suddenly make supercomplex origami approachable for a complete beginner. My advice if you are a newcomer who wants to fold difficult models is to work your way up slowly – practice and patience are the two crucial ingredients to improvement.

Below is a rough guide to help you work out what models will be appropriate for your experience level.

Simple

This model is essentially as simple as origami gets, so is accessible to anyone. You should still read the terminology section to familiarise yourself with the most standard terms, symbols, and manoeuvres. Start with these models if you have no origami experience.

Low Intermediate

This model is a little longer and more involved than a simple model, but fundamentally there isn't anything too challenging.

High Intermediate

It is assumed that the folder has mastered the standard folds and is looking to move on to trickier manoeuvres, such as sinks and collapses.

Complex

You should be comfortable with all named origami manoeuvres. Models will be challenging, and little explanation will be given for common folds. Do not expect any limit on diagram length when folding a complex model.
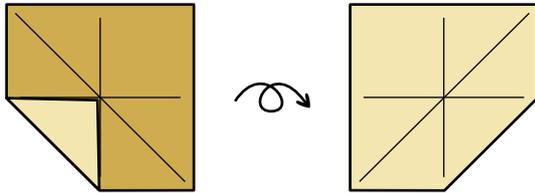
Super Complex

Nothing is off-limits, and there is normally something particularly fiendish about a super complex model. The folder should be familiar with not just all individual folds shown in the diagrams, but also with generally reading and folding from a crease pattern, as this is the most sensible way of sharing a super complex model.

NOTE

Difficulty ratings for a model are somewhat relative to the other models in the same book in order to differentiate between them effectively. This means that occasionally a model in one book might be slightly harder than another model with the same difficulty rating in another book.

TERMINOLOGY

The first occurrence of an origami-specific term will be in bold and accompanied by the definition.

Note that while understanding the terminology is useful, the text is merely a supplement to the images and is not enough to fold from alone. Use the images as the default method of reading the diagrams.

Raw corner – The actual corner of the paper.

Raw edge – The actual edge of the paper.

Intersection – A point where creases and/or edges meet.

Crease – A line that has previously been folded but is now flat. In a diagram, creases terminate a short distance away from a raw edge.

Corner – A point where the paper forms an angle less than 180°.

Coloured side – The side of the paper which is usually intended to be seen in the final model.

Edge/folded edge – An edge created by folding.

White side – The side of the paper which is usually intended to be hidden in the final model.

Flap – A portion of paper that can independently swing about an axis.

Angle bisector – A line that halves an angle.

Base – The partially-folded stage of a model when all required flaps have been created, but there has been no artistic shaping. A base is **axial** if there is a line which passes through all flaps, and all flaps hinge on lines which are perpendicular to this line. Such a line is called the **axis** of the base. Creases which end up on the axis after folding the base are **axial creases**.

Diagrams – The set of images (and accompanying text) used to convey a folding sequence.

Crease pattern (CP) – The folds used to create the base of a model.

Symbols

**Turn over** – By default, the symbol means flip the paper over from left to right.

**Reference point** – A small blue circle highlights an important position.
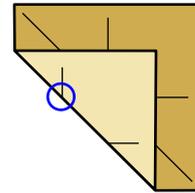
Zoom in/out – A large blue circle with zoom lines shows more detail than can be normally seen for one or more steps.
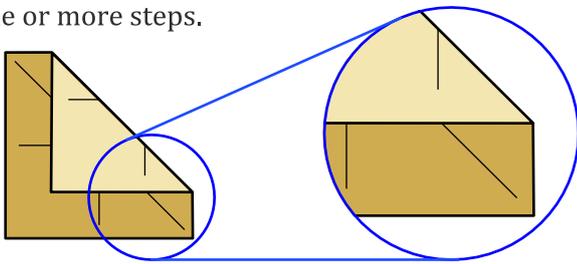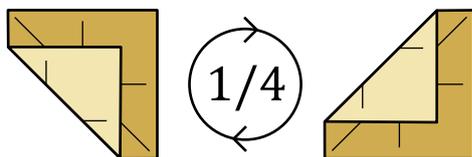
Hidden/imaginary line – A relevant line that cannot be seen directly will either have an x-ray view or will be dotted (or both).
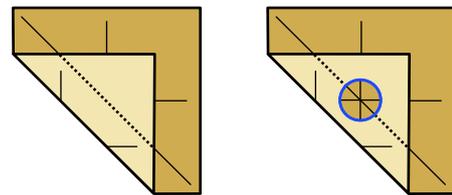
Repeat – Repeat the numbered step(s) on the region(s) shown. Repeating one action on the reverse within the current step is shown in the same way.

3.   4.   5.

2.   3.
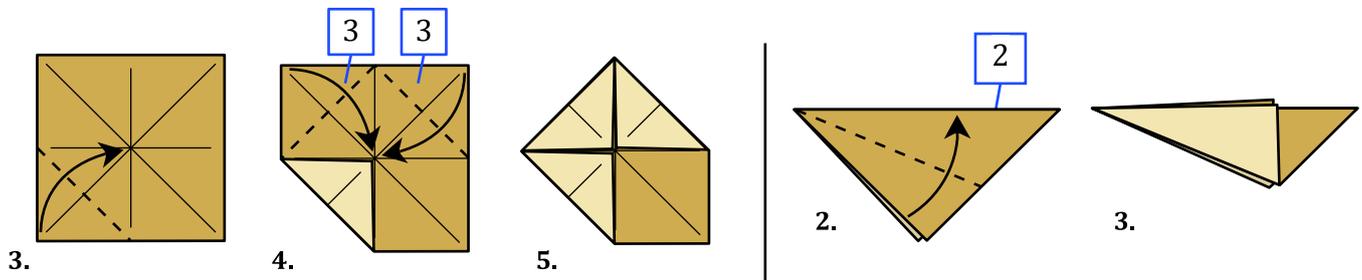
Rotate – Turn the paper in the direction shown by the number of turns given.

1/4

Push arrow – Push here/move this bit of paper.

Open/inflate – Open up a part of the paper.

Right angle – This symbol shows two perpendicular lines (you may need to imagine one of the lines being extended).
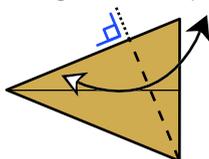
Divisions – Split the length into the proportions shown. This normally means dividing into equal sections, possibly with no folding sequence given.
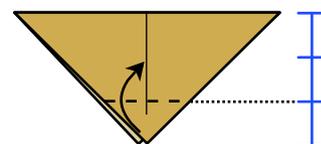
MANOEUVRES

These are the named types of fold. Note that, where applicable in the text, the hyphenated form of a manoeuvre is the verb and the non-hyphenated form is the noun.

Fold/valley fold – A dashed line shows where to make the fold, and this line is called the **fold-line**. An arrow with a symmetric solid black arrowhead shows the motion of the paper.
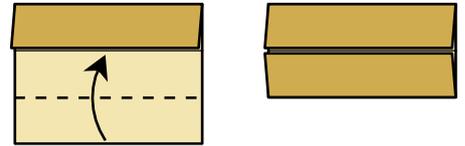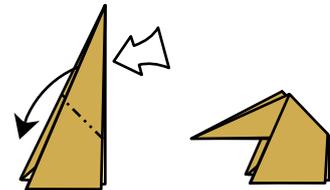
Mountain fold – A mountain fold is the opposite of a valley fold. It involves folding some paper behind, and the fold-line is shown with a dot-dot-dash pattern. A white hooked arrowhead shows the motion of the paper.
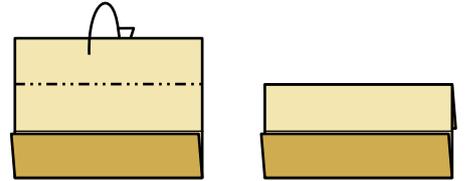
Unfold – A symmetric white arrowhead shows an unfold. This will often be combined with a valley fold in one arrow, and the text will say "fold and unfold".
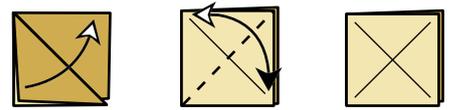
Reverse fold/inside reverse fold – An inside reverse fold is used where two or more layers of paper meet at a line called a **spine**. The spine is pushed in on itself and changes orientation from a mountain to a valley. An arrow shows the direction of motion.

Outside reverse fold – An outside reverse fold is the opposite of an inside reverse fold – the valley fold is on the front layer and the mountain fold is on the back. An outside reverse fold wraps the paper around itself so that the spine faces outwards.
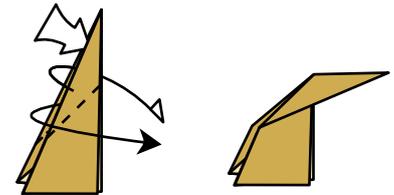
Squash fold – A squash fold is used to open out and flatten a folded edge symmetrically. This is like performing an inside reverse fold, but leaving the spine open.
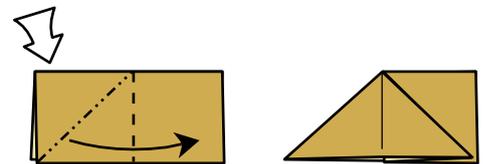
**Swivel fold** – An asymmetric squash fold is called a swivel fold.
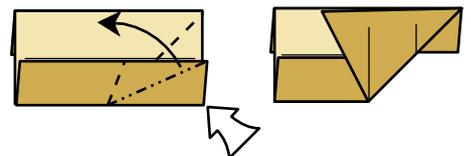
Rabbit ear – A rabbit ear combines three valley folds and a mountain fold at once. Usually this brings all three sides of a known triangle to lie along one line.

Pleat – A valley fold and a mountain fold performed together is called a pleat. Often this is done with a pair of parallel lines.

A diagram will usually have a symbol to show what is happening to layers of paper that can't be seen directly.
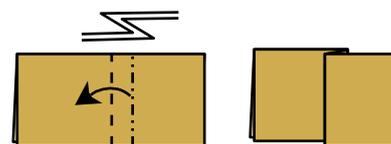
Preliminary fold – One of the standard origami bases is called the **Preliminary Base**, shown on the right above. The folds used in making this base are replicated frequently enough that it has become a manoeuvre in its own right to refer to a similar type of fold. A **Waterbomb Base** uses the same combination of folds, but begins with the square rotated an 1/8 of a turn, and is shown on the right below.
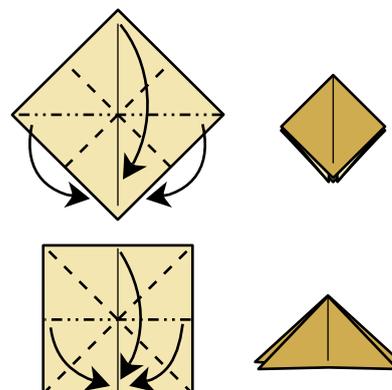
Mixed reverse fold – Sometimes a reverse fold will involve multiple spines. Such a reverse fold will combine an inside reverse fold at one spine and an outside reverse fold at another. By default, it should be assumed that the mixed reverse fold doesn't lock any layers.
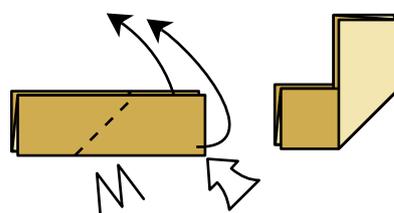
Crimp – A crimp is a combination of two reverse folds performed at the same time. Where the reverse folds can be performed individually, the text will often say "reverse-fold in and out" rather than directly referring to a crimp.
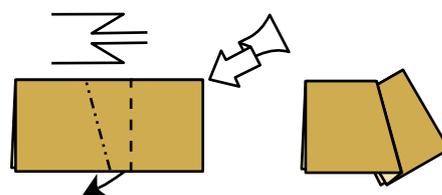
Petal fold – A petal fold combines two swivel folds which are side by side. Often the two swivel folds are mirror images of each other.
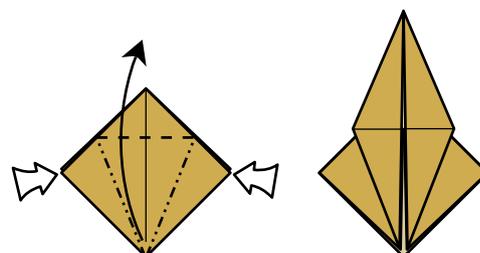
Double swivel fold – A double swivel fold combines two swivel folds, one in front of the other. This is a bit like an inside reverse fold, but involves rotating a partially hidden edge.
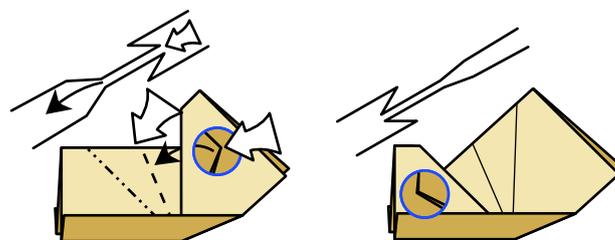
Double rabbit ear – A double rabbit ear combines two rabbit ears. Usually the rabbit ears are mirror images of each other with one on the front and one on the back.
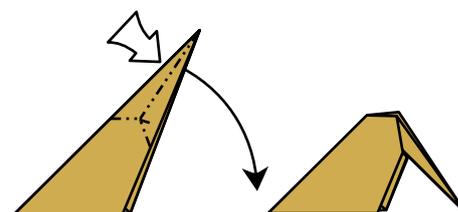
Spread-sink – A spread sink is like a squash fold (and is sometimes called a spread squash or squash sink), but doesn't have any folds terminating at the edge of the paper.
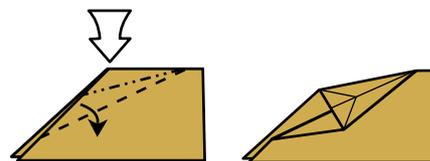
Open sink – The standard form of sink is the open sink which is most easily performed by opening and flattening the region to be sunk, pinching a mountain ridge along the entire folded loop, then inverting the area within the loop.
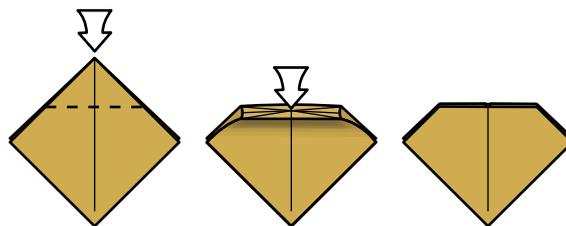
Closed sink – A closed sink is like an open sink, except it locks the layers of paper together. Hold all flaps together and invert the point/edge at the top. The paper cannot be fully opened and flattened, but instead, the paper will resemble a cone during the sink.
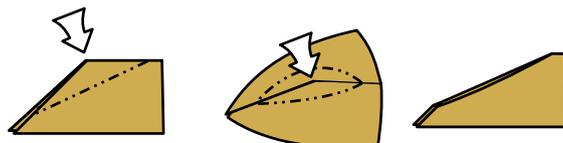
Mixed sink – It is possible for a sink to be neither fully open nor fully closed. If a model requires a mixed sink, then either a diagram or the text will specify which flaps need to remain free or become locked.
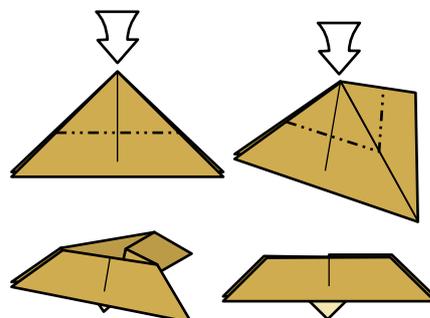
Double sink – Successive sinks can be combined in one diagram (and by default assume that these will be open sinks). Similarly, sometimes three or more sinks can be combined in this way. The text will usually say "sink in and out" rather than naming a double or triple sink etc. for these general multi-sinks.
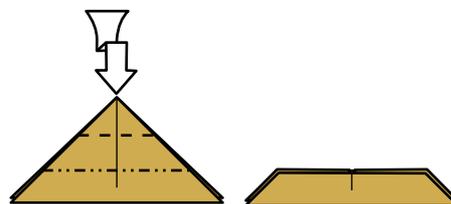
Unsink – Sometimes a point needs to be folded in a way that looks like the undoing of a sink. These are some of the trickiest individual manoeuvres, so be patient and be prepared to open up the paper significantly to achieve the result.

Box stretch/Elias stretch – A box stretch straightens the edge of pleats to sharpen two points on either side. The paper often has to be opened out significantly. This manoeuvre is usually performed in box-pleated or hex-pleated designs.
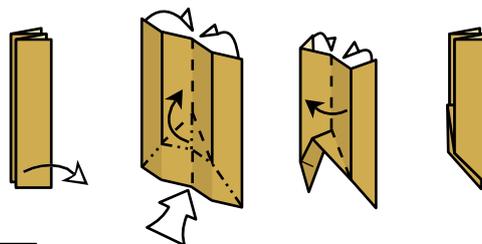
Collapse – A collapse is the catch-all term for a combination of folds not covered by any other named fold. Naturally, these are often the most difficult steps.
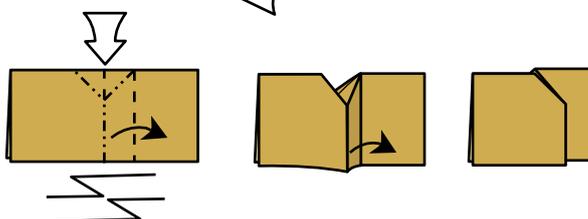
PAPER

What type of paper should I use?

Standard origami paper (*kami*) is coloured on one side and white on the other and is reasonably thin. This is the cheapest and most readily available origami paper to use, but it won't be appropriate for many complex models because it has a tendency to tear, won't hold its shape, and is often not large enough.

For complex origami, expect your first attempt(s) to have some mistakes – such a model is a **test model** (this is often called a **testfold** elsewhere). You will only make a more polished version – called a **display model** – when you are more familiar with the folding sequence.

For test models, the only paper requirement is that you can progress far enough to see all the steps and prepare yourself for making a display model. I recommend using whatever paper means you can practise most affordably (I often unfold other models and use the same sheet of paper for test models).

However, each model has specific paper attributes required to make the most effective display model. These attributes might be any of the following:
- **Duo** – The paper has different colours on each side. This is for any model which has a **colour change**, meaning it deliberately uses both sides of the paper, so the final model uses two colours.
- **Thin/ultra thin** – Roughly speaking, the paper weight is less than 50gsm/30gsm respectively. This is needed when there are lots of layers in some parts of the model.
- **Shapeable** – The paper will stay in place after folding. **Sandwich paper** – two layers of tissue paper surrounding a sheet of foil – is particularly effective here.
- **Wetfoldable** – The paper can be dampened before being folded into shape and will then stay in shape after it dries. This technique is an optional alternative to using shapeable paper.
- **Textured** – The paper is not entirely plain so is useful for mimicking fur, scales, wood etc.
- **Tearproof** – The paper is strong enough that it won't rip at particularly high stress points.

You can either choose your paper based on the attributes above or use the recommended paper. One particularly good choice, if you are willing to invest the time, is to prepare double tissue paper, which satisfies most of the requirements above in one paper.

How do I make double tissue paper?

There are multiple similar methods people use to make double tissue paper. Below is the method I use, with measurements suitable for making a 45cm/18'' sheet.

You will need:
- A large flat, non-absorbent board, at least 55cm/22'' in width and length. A sheet of glass is a common choice, but a standard 'self-healing' cutting board does the job perfectly well here. This should be larger than the tissue paper you will need.
- Two sheets of large tissue paper at least 50cm/20'' in width and length.
- Methyl cellulose powder (MC).
- A spoon or another mixing implement.
- A bottle with a lid.
- Water.
- A long cylinder.
- A wide paintbrush.

Method:

1. Stir around 30ml / ⅛ cup of methyl cellulose in about 250ml / 1 cup water.
2. Mix thoroughly and leave it to rest until you cannot see any clumps of powder (stirring again if necessary). This usually takes at least 4 hours.
3. Spoon the mixture into the bottle and then add another 250ml / 1 cup water. Put the lid on (tightly!) and shake the mixture.
4. Leave the bottle to rest until there are no visible air bubbles. This usually takes at least 12 hours. After this, the mixture will be clear, and be noticeably more viscous than water.
5. Clean the board and the paintbrush thoroughly to remove any dust or dirt that you don't want in the paper.
6. Pour about 60ml / ¼ cup of the MC solution on the board. Use the paintbrush to spread the mixture evenly across the board, covering an area larger than the tissue paper you will be using. Add more MC solution if necessary.
7. Roll one sheet of tissue paper around the cylinder, avoiding any wrinkles. This will be the first sheet, and will be wetter than the second sheet. This means the colour is more likely to bleed out of this sheet, so if you are using two different colours, you should use the lighter coloured sheet here.
8. Unroll the tissue paper onto the board so that it doesn't have any wrinkles. Use the paintbrush to brush any air bubbles to the sides out from under the tissue paper, so that it lies completely flat. Do this carefully because the wet tissue will tear easily – a wide paintbrush prevents too much pressure in any one spot.
9. Roll the second sheet of tissue paper around the cylinder, again avoiding any wrinkles.
10. Unroll the second sheet of tissue paper onto the board so that it overlaps with the first sheet. There should be enough liquid that there are no dry patches. If there are dry patches, carefully brush a small amount of the MC solution over these regions. As before, use the paintbrush to brush any air bubbles to the sides out from under the tissue paper so that it lies completely flat.
11. Leave the paper to dry fully. This could take more than 24 hours. It is important not to peel off part of the paper while it is wet, because the peeled region will become stretched relative to the rest of the paper even when it dries.
12. When the paper has dried, peel it carefully off the board and cut it to size (see the next page).
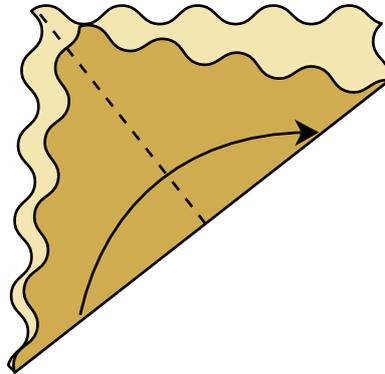
What shape of paper do I need?

Most origami models start with a square sheet of paper. If you are preparing your own paper, you will need to cut it to a square shape yourself. Here's one method you can use for preparing an exact square:
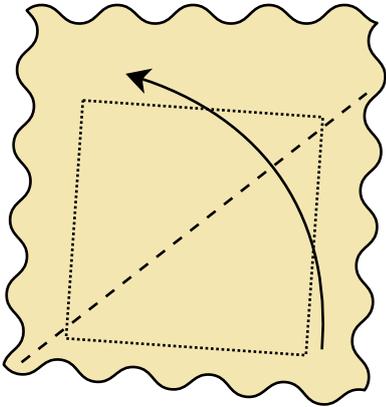
1. Imagine roughly how the largest possible square would fit on your paper. Fold an approximate diagonal for that square.

2. Fold the edge onto itself.
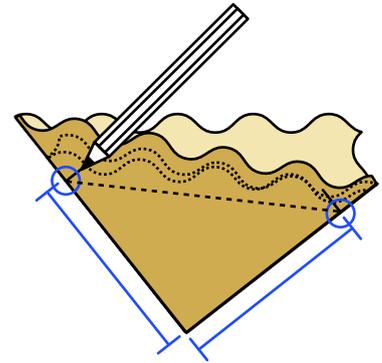
**3.** Using a sharp pencil and a ruler, mark two points, one on each folded edge, which are the same distance from the right angle. Ensure that the line connecting the points doesn't cross any of the original edges of the paper (some of which are hidden).
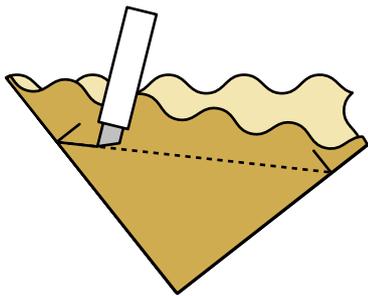
4. Using a cutting tool, such as a craft knife, carefully cut along this line. Make sure the layers do not slip as you cut the paper.
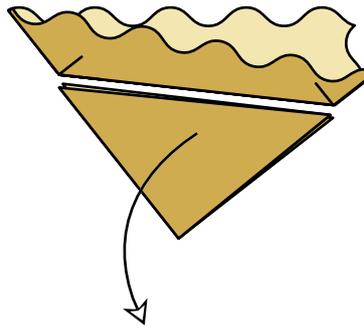
5. Unfold to get your square.
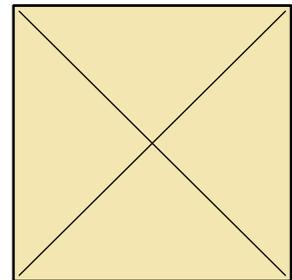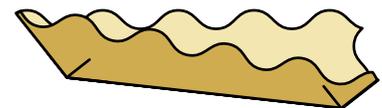
How big should my paper be?

Each model has a recommended width (side length of the square) for the first time you fold a model, which is intended to be the most comfortable width when the model is folded on its own.

On step 1 of each model is an image of the final model relative to the starting width of paper, which you might want to use as a guide to create a to-scale scene with multiple models. This can put a significant constraint on the starting paper width on some models, so be prepared for a significant challenge if you wish to fold such a scene.

Lengths are all multiples of 5cm/2'', for the sake of convenience and adhering to convention.