

# From Origami to IKAROS

## Applying Folding Technology to Space Technology

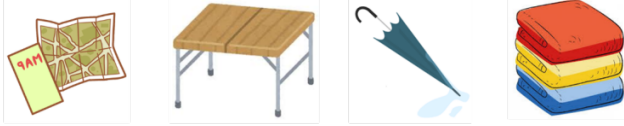
Akira Yo (Mathematical Sciences, Seikei Junior and Senior High School)

E-mail: a-you@th.seikei.ac.jp

### 1. Outline

There are all kinds of things you can fold.

For example...

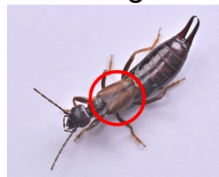
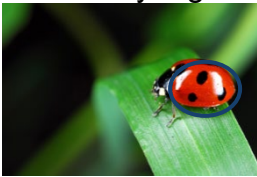


Folding can make these big things smaller.

The natural world also has folded their hind things.

Insects fold their wings when not using them.

Examples: • A ladybug's wings • An earwigs wings

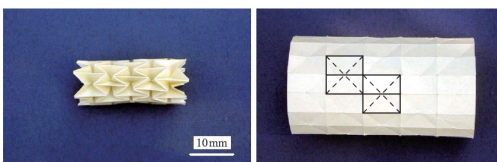
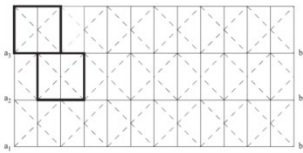


The mechanism of how these insect hind wings are folded was clarified by Japanese researchers.

In Japan, we have a traditional art called origami, so folding is something very familiar to Japanese people. → Origami engineering was born.

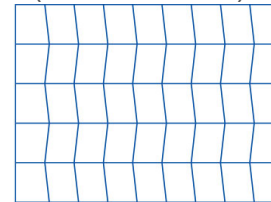
### • Applying Origami to Various Technologies

Applications in the medical technology field (sea cucumber fold)



Used in artificial blood vessels.

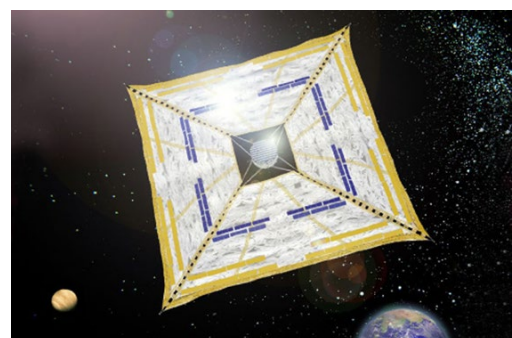
Applications in the space technology field (the Miura fold)



Various experiments have been conducted, including extending the solar sails of satellites.

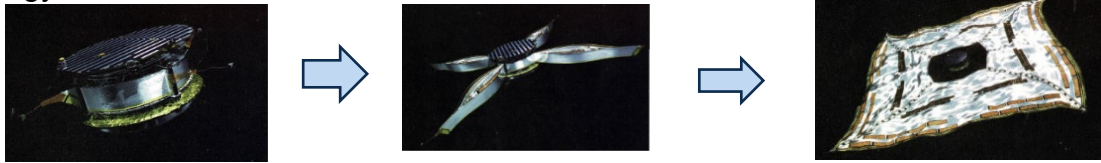
### • Applying Origami to IKAROS

Origami technology is also applied to the solar sail of IKAROS (Interplanetary Kite-craft Accelerated by Radiation Of the Sun) launched in 2010.



- Unfolding IKAROS's solar sail

Origami technology is used to store IKAROS's solar sail.

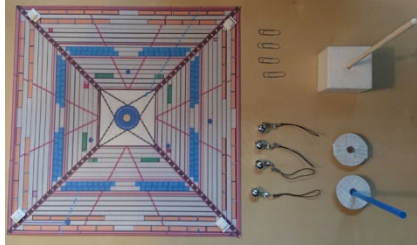


Centrifugal force is used to unfold the square solar sail smoothly.

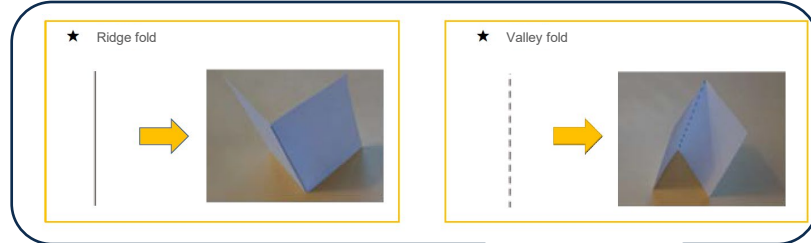
## 2. Today's Activities

Let's conduct an experiment to unfold IKAROS's solar sail.

- **Materials**

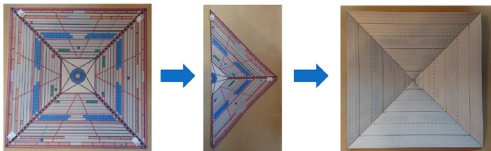


- **Instructions**



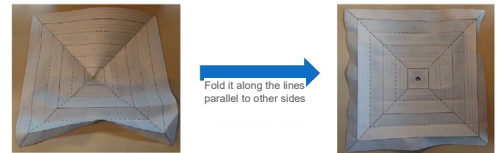
### STEP1

Fold the sail in half along the two diagonals so that the illustration remains visible. Then make creases.



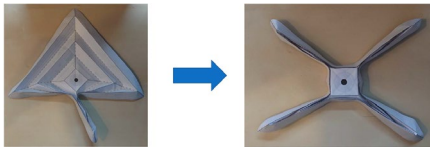
### STEP2

Following the above folding rule, fold the sail along the lines parallel to the four sides, and make creases.



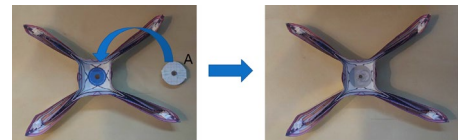
### STEP3

Following the previous folding rules, fold it along the diagonal from each corner point and furl it.



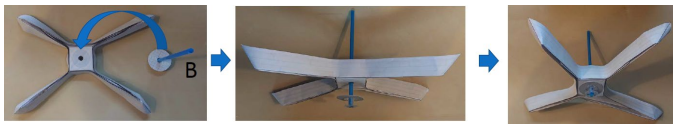
### STEP4

Turn the sail over, peel off the double-sided tape on Part A, and stick it so that the holes in Part A and the sail overlap.



### STEP5

Turn the sail over, peel off the double-sided tape on Part B, insert a straw through the hole of the sail, and stick it together.



### STEP6

Take a bell by its string and hang it on the hook of the sail. Repeat this for each hook.



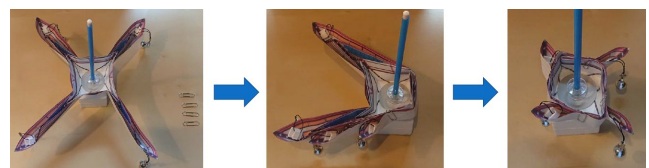
### STEP7

Peel off the double-sided tape on the rear of Part C and stick it to the desk. Put the sail straw from earlier through the bar of Part C.



### STEP8

Wind the straps clockwise around the cross part of the sail and fix it at four locations with clips.



As shown above, remove the clips you made from IKAROS and use your hands to rotate the straw counterclockwise!!