



# STATE DA VINCI DECATHLON 2018

CELEBRATING THE ACADEMIC GIFTS OF STUDENTS  
IN YEARS 7 & 8



## ENGINEERING

TEAM NUMBER	
TOTAL	/36
RANK	

# UMBRELLA BREATH

## BACKGROUND



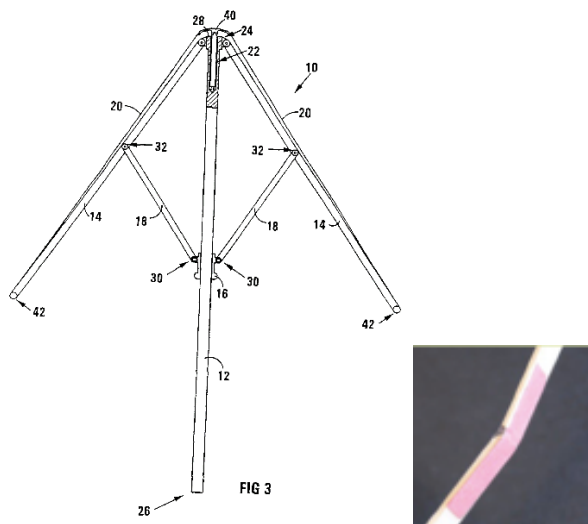
The umbrella is one of the most powerful tools against the unexpected. Originally used as a shade from the sun, from as early as the 4<sup>th</sup> Century B.C., the umbrella was an item of royalty and built with aesthetics in mind. Now, it has now become a mass-produced practical tool for wet weather. The unassuming single stick shape can be abruptly, unexpectedly, opened to reveal a protective canopy, much larger than the original surface area.

In producing a fold-away umbrella, a simple mechanism was built, illustrated below. Branches which hold up the material are connected by an arm to the centre stem, held together by a tight band. By pulling the band higher or lower, the arms change angle, causing the branch to open or close. It is because of a series of carefully designed hinges at the points between these elements of the design that the umbrella is able to operate so seamlessly.

## THE TASK

Engineers often take inspiration from the simple and mundane, leading to serendipitous discoveries of complex technologies from what is often in plain sight. In 2015, an invention disclosure outlined the concept of applying the **umbrella design** to build a new bio-compatible **artificial breathing mechanism** which could be placed in an artificial lung that is then able to replace a natural but non-functioning lung. The design suggested using **six** branches, all connected to a main stem. Many of these systems would then be placed around a larger base and a bag type cover would be placed over all the systems. By moving the systems in synchrony, the branches as they open would increase the size of the covering bag, mimicking the action of our lungs.

To be able to finally produce such a complex design requires consideration separately of each single component. Your task is to focus on one – a single stem system. You are required to build a **working** model using coffee stirring sticks, tape and paper/cardboard of one 'umbrella' system. The system must have **6** branches. To make sure your design functions, consider developing the hinges by connecting different sticks together using paper/tape (see the picture below).



## DESIGN STATEMENT

The single stem system must contain the following:

1. A central stem, with **six** arms/branches connected via hinges and a central ring
2. A functioning ring, which when moved will cause the branches to open and close
3. The stem need not necessarily be a single piece of material. You may consider breaking up the system into **smaller components**, then combine these components together to form a larger collective central stem!

Once submitted, the examiners will test the functionality of your design as well as assess the model quality.

**Questions related to the task follow** on page 4. These contribute separately to the overall mark for this task and should be read before building the model.

## DESIGN PARAMETERS

You will have **sixty minutes** to design and construct your stem system. The system will be marked according to the marking criteria below.

You will be provided with a number of materials. It will be up to the team to decide what materials to use to construct the stem system. You are able to select from the following materials:

- 1 piece of A4 paper
- 1 piece of A4 cardboard
- 25 coffee cup stirring sticks (paddle pop sticks)
- Your own stick tape (and scissors to cut materials)

## MARKING MATRIX

Criteria	Skilful	Effective	Sound	Limited
Functionality of opening mechanism	5	4	3	2-0
Design based on aggregated smaller units	5	4	3	2-0
Use of materials	5	4	3	2-0
Overall <b>design</b> of mechanism	5	4	3	2-0
Quality of model design	5	4	3	2-0
Design considerations	6	5	4	3-0

<b>TOTAL</b> <b>/31</b>
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