STATE DA VINCI DECATHLON 2017

CELEBRATING THE ACADEMIC GIFTS OF STUDENTS IN YEARS 5 & 6

ENGINEERING

TEAM NUMBER _____

FLOWERING TURBINES

BACKGROUND

Wind turbines are becoming a valuable tool to harness renewable energy as our non-renewable sources, such as coal and gas, are becoming scarce. Wind energy is also environmentally friendly – the fossil fuels released by coal power are non-existent when harnessing the power of wind. While not always reliable, due to the variable nature of wind, wind farms are used as a method to supplement a more permanent energy source, by filling storage batteries with additional energy that can be used during peak power usage periods.

Wind, the movement of air particles, has kinetic energy. When the wind hits the blades of a turbine, the kinetic energy is transferred to the blades. A rotor inside the wind turbine spins as the blades spin, which in turn powers an electrical generator that produces electricity. Depending on how well the wind turbine is designed, the efficiency of the turbine in converting energy from the wind to electrical energy can be maximised. For example, increasing the size of the blade will increase the surface area with which the wind can collide, maximising the amount of energy that can be transferred to the turbine. Similarly, the more blades in a turbine will also increase energy collection. If the blades are too heavy, then a lot more energy will be required to move a blade compared to a lighter one. Other factors such as shape, material and the angle of blades also greatly contribute to energy collection. Below are a few pictures illustrating the creativity of wind turbine design development:

Building farms of wind turbines is the only way to harness enough energy for practical use. Wind farms, however, require vast amounts of space and significantly impact the area they are built on. If built on farms, as in European countries, or deserts and parks, as in Australia, the natural environment and eco-system is greatly disrupted. Animals may become injured, the aesthetics of the location may be lessened or soil may become contaminated by the metals and materials used in the turbines.

Engineers proposed the solution to locating wind farms is moving them offshore to produce floating wind farms on oceans. This has proven, however, to be overly expensive and impractical for maintenance. Instead, engineers have begun looking to nature and designing turbines based on biomimicry – the technique of mimicking nature to create a design that blends with its natural surrounds. In doing so, the land based wind farms will be incorporated into their natural setting.

THE TASK

Your task is to employ biomimicry to design a novel wind turbine that is built to blend into its natural surroundings. This may involve looking at the shape of trees, flowers or plants such as vines to structure your turbine. You might also look at elements of these natural organisms, such as their leaves or branches, to consider how your turbine will harness the wind energy. Once designed, you must create a working model of your natural wind catcher that demonstrates how the wind energy will be harnessed. Consider the factors of efficient wind turbines above when designing your natural wind catcher. Also be creative – your design may not even include blades but instead a new mechanism to capture the wind power!

DESIGN STATEMENT

Your natural wind catcher working model is not required to include a rotor and gear system for the model. It does need to contain parts that when subjected to a wind like pressure will move. If your design incorporates multiple mini-turbines then you only need to have a maximum of **one** working turbine. The wind catcher must have elements that reflect consideration of the factors contributing to turbine efficiency as mentioned in the background information above.

Questions of design details (6 marks) and a design sketch (page 5) must also be completed.

DESIGN PARAMETERS

You will have **sixty minutes** to design and construct your natural wind catcher. The wind catcher will be marked according to:

- Novel biomimicry design that blends the wind turbine with nature
- Original mechanism used to harness wind energy
- Strength and stability of model
- Use of materials
- Quality of model making
- Design details
- Design sketch

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 turbine. You are able to select from the following materials:

- 3 pieces of A4 paper
- 2 pieces of A4 cardboard
- 4 plastic straws
- 6 pipe cleaners
- You may also use your own sticky tape, but sparingly.

*Team No.:*_____

MARKING MATRIX

Criteria	Skilful	Effective	Sound	Limited
Biomimicry design (use design details/model)	5	4	3	2-0
Wind harnessing Mechanism (use design details/model)	5	4	3	2-0
Strength and stability	5	4	3	2-0
use of materials	5	4	3	2-0
Quality of model design	5	4	3	2-0
Design details	6	5	4	3-0
Design sketch	5	4	3	2-0

TOTAL /36

DESIGN DETAILS (6 MARKS)

1. Describe the mechanism you have designed to harness wind power. (2 marks)

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2. Explain how you have addressed the factors in the background information to maximise efficiency. (2 marks)

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3. Explain how your design blends with nature. (2 marks)

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DESIGN SKETCH (5 MARKS)

Briefly sketch your design with approximate proportions, labelling any important features.