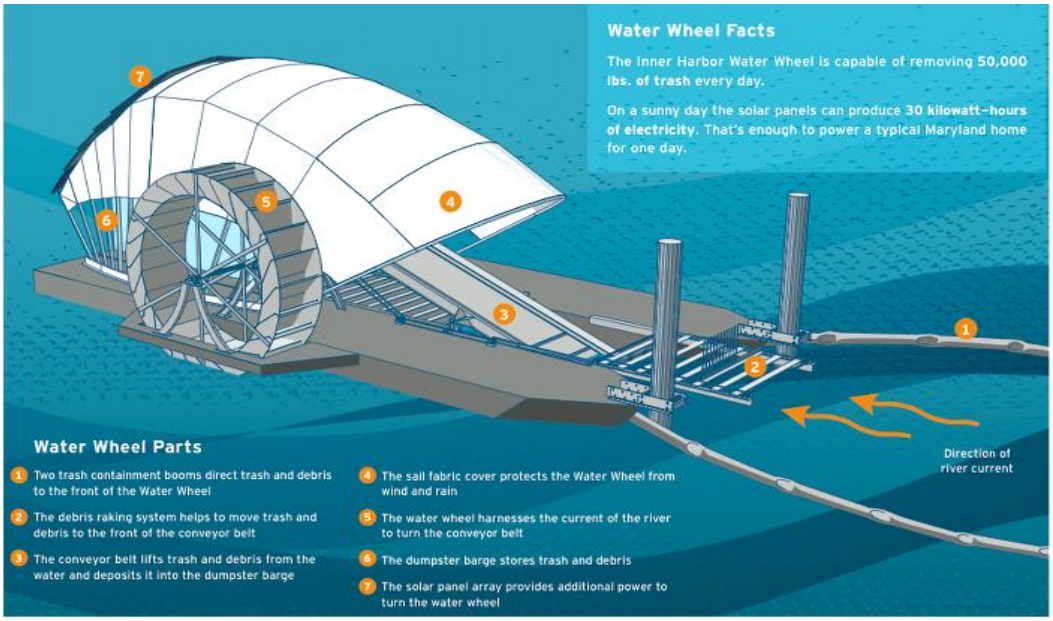
STATE DA VINCI DECATHLON 2017

CELEBRATING THE ACADEMIC GIFTS OF STUDENTS IN YEARS 9,10 & 11

ENGINEERING

TEAM NUMBER _____

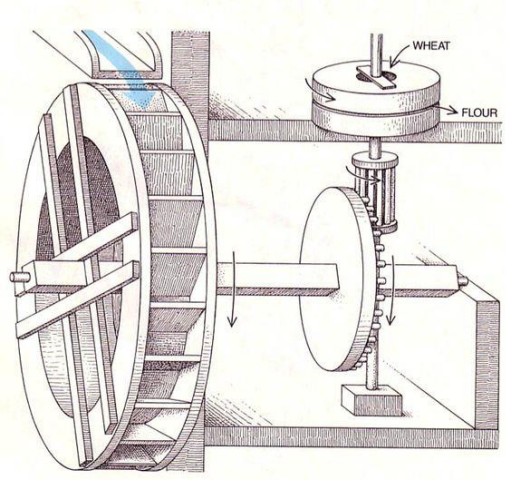
GREEN GARBAGE COLLECTOR



BACKGROUND

As we increase the use of plastics and non-biodegradable materials, the amount of accumulated rubbish in our waterways continues to increase. The term 'ocean soup' has recently been popularised to describe the masses of pollution we have accrued in oceans. Due to the currents in our globe's oceans, this pollution has coalesced into a few vortexes to form the great pacific and western garbage patches. The devastating impact of these are myriad: organisms that consume micro-plastics no longer survive, toxins from the plastics leach in the water causing bioaccumulation of fatal chemicals in food chains and plant life can no longer survive with intertwined plastics amongst their leaves.

Many activists and engineers have designed bots, drones and AI controlled barges to collect the garbage, but these methods are costly and temperamental. In search for a low maintenance, reliable and effective garbage collector, engineers have developed the prototype you see above. The prototype consists of a conveyer belt on a barge that is powered by solar power. It will float along local shores, without any external control, and collect any garbage it passes using the conveyer belt. At the top of the conveyer belt, hidden under the fabric, is a disc that rotates (see to the right). Once the garbage reaches the top of the conveyer belt, the waste falls onto the disk. A low powered AI determines whether the collected items are indeed waste or living organisms, and sorts the items accordingly. Further systems have been designed to then identify when the rubbish storage is full and how the garbage is collected.



THE TASK

The issue for you to address is modelling how to power this prototype during the night. Without solar power, engineers turned to the ancient water wheel – a wheel that spins continuously due to the weight of water that is collected in the numerous troughs located around the wheel. Your task is to engineer a mechanism that moves the conveyer belt **and** the rotating disk using the spinning of the water wheel. Be creative and judiciously select materials when working out how to move the conveyer belt. To rotate the disk, you are required to design **one** cog system as illustrated to the right. The cog will allow the disk to rotate parallel to the water using the movement of the water wheel, which rotates perpendicular to the water. Once designed, you must produce a working model of your water wheel powered conveyer belt and disk system. When building your model, consider material choices that minimise friction in order to maximise power conversion from the wheel to the belt and disk.

DESIGN STATEMENT

The model must be self-supporting and moveable to the marking area. You will have **TWO** minutes at the marking area to set up the model if required. Markers will spin the water wheel by hand to view the movement of the conveyer belt and disk. It is not necessary to include any detail on each component: a circular piece of paper can represent the disk and a conveyer belt needs only be made of flat paper. The water wheel, at a minimum, must contain two circular sides that are connected by **at least 4 troughs.** The wheel spins around a central axis. You will not be marked on model size – only functionality and design.

Complete the design sketch and details on pages 4-5. These will not only be marked independently for the design details marking component, but also to assist with marking the first 5 criteria.

DESIGN PARAMETERS

You will have **sixty minutes** to design and construct your water wheel garbage collector. The model will be marked according to:

- Design and spinning of water wheel
- Functioning mechanism to move the conveyer belt
- Functioning cog mechanism to move the disc
- Aesthetic of model
- Quality of model making and use of materials
- Design details (page 4-5)
- Design sketch (page 5)

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

- 6 pieces of A4 paper
- 4 pieces of A4 cardboard
- 4 straws
- 8 paper fasteners
- 20 cm of string (twine)
- sticky tape (your own)

Team No.:_____

MARKING MATRIX

Criteria	Skilful	Effective	Sound	Limited
Water wheel design/spin	5	4	3	2-0
Mechanism of conveyer belt (fully functioning belt that loops due to movement of wheel)	5	4	3	2-0
Cog for disk spin (a cog system that is functioning, ideally 1:1 spin ratio)	5	4	3	2-0
Aesthetics (limited sticky tape, cohesive, scaled appropriately)	5	4	3	2-0
Quality of model design (original use of materials, stable and strong, very high attention to detail)	5	4	3	2-0
Design details	6	4	2	1-0
Design sketch	5	4	3	2-0

TOTAL /36

DESIGN DETAILS (6 MARKS)

1. Explain your mechanism to move the conveyer belt using the water wheel. You may refer to your design sketch when explaining (2 marks)

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2. Explain the design choices made to minimise friction in the model (2 marks)

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3. Designers not only design, but also work out where to apply their creation. Describe one other application of a water wheel to generate power in our modern world that would be more effective than relying on other renewables (solar, wind etc) or grid electricity (2 marks)

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DESIGN SKETCH (5 MARKS)

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