THE OBSERVATORY

A PLACE TO LOOK IN - A PLACE TO LOOK OUT

The Observatory

Engineering Design Challenges

Resource Sheet 7

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Resource Sheet 7:
The Observatory – Engineering Design Challenges

Look in, Look out…Explore contemporary art and architecture and unlock learning across the curriculum with The Observatory.

The Observatory offers students and teachers an engaging and inspirational way to learn about contemporary art and design in two very special locations. Whether through the study of the structure's unique design and engineering, learning about the local landscape, or exploring the work of practicing artists, The Observatory supports learning for students across the school age range in subject areas including: Art & Design, English, Geography and Science. The Observatory also supports the objectives of the Learning Outside the Classroom and Learning Through Landscapes programmes.

What is The Observatory?

The Observatory is a sculptural installation, an intervention, a space, a platform, a shelter, a look-out where a series of artists will take up residence in two special locations over the next year.

- *Winchester Science Centre/South Downs National Park – February to July 2015*

- *Lymington Keyhaven – July to December 2015*

The Observatory is an excellent example of how design responds to a multi-faceted brief and offers students the opportunity to explore contemporary architecture in their locality, first hand.

The Observatory's unique and beautiful design includes a studio space for the artists and a workshop that is totally accessible to the public. The design features the use of sustainable materials and a specially engineered rotating base, which allows The Observatory to capture 360 degree views, whist also being light on the landscape.

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The Observatory provides a unique opportunity for students to engage directly with contemporary artists, learn about their working practices and understand how they respond to the world around them.

Six artists will be resident in The Observatory over the next year. Working in a variety of mediums including: drawing, sculpture performance, printing, and animation, the artists will create site-specific work in response to the landscape and to their experience of working in The Observatory.

For more information about The Observatory, visit our website:

www.lookinlookout.org

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Using this Resource Sheet

This Resource Sheet explores the engineering used for The Observatory that allows it to rotate 360 degrees and to be transported easily to different sites. Students can explore these engineering design challenges behind the rotating mechanism and gain an understanding of concepts around rotation, effort and weight distribution. Students can also learn about how engineers solved the challenges of transporting The Observatory by road and across difficult terrain, and with minimal impact on the landscape.

This Resource Sheet forms part of the *Design & Build Your Own Observatory* scheme of work, but can also be used as a stand-alone resource. **Suggested activities** for using this resource include:

- Design and build a rotating mechanism based on The Observatory.
- Explore different rotating mechanisms with differently weighted structures.
- Explore lifting differently weighted structures, with and without lifting bars.
- Explore transportation of differently weighted structures across different terrain, using a variety of means.

The use of this Resource Sheet can be supported and enhanced by visits to The Observatory and/or workshops led by SPUD or the resident artists in school. For more information, please contact: **Kristina@spudgroup.org**

Engineering Design Challenges

The design of The Observatory had two unique challenges that were solved by a simple piece of engineering. Firstly, The Observatory's unique design allows the artist to rotate the structures 360 degrees to take advantage of different views of the landscape, or protect the structures from the prevailing wind. So the first challenge was how to make the heavy Observatory rotate with little effort.

The Observatory also needs to be transported to 4 separate locations over the next two years. So the second design challenges was to create a simple way to transport The Observatory with minimal impact on the landscape.

This is how a simple piece of engineering solved both design challenges for The Observatory.

The Engineering Brief

The brief for the engineer was to create two separate platforms that:

- Rotate with minimal manual effort
- Could be easily transported via a road going lorry and lifted using a HIAB crane,
- Could be transported across uneven terrain,
- Could be placed and leveled and left to operate with next to no servicing for four periods of 6 months.

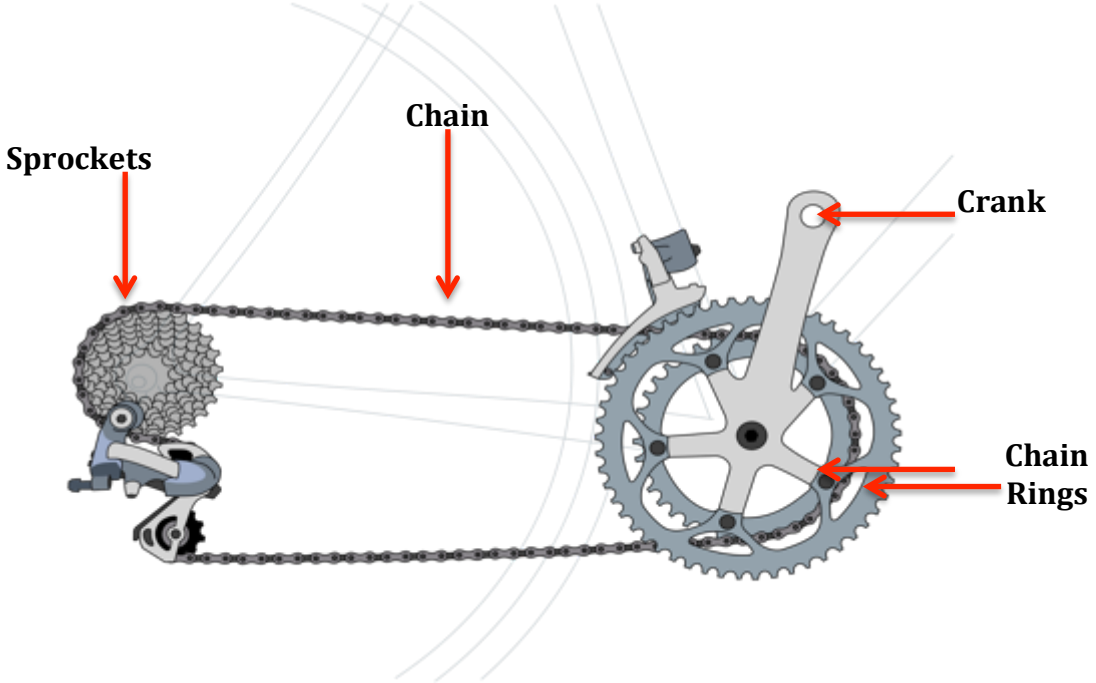
Rotation

The rotating mechanism for The Observatory is similar to the crank and chain system on a pushbike. Imagine laying your pushbike on the ground and turning the pedals… what happens? The rear wheel turns whilst the bike stays still. Now imagine holding the rear wheel still…what happens now? The bike wants to rotate around the rear wheel?

Two platforms form the base for The Observatory to sit on - one sits directly on the ground and stays still (the Stationary Platform) and one sits on top of the Stationary Platform and rotates (the Rotating Platform).

On a pushbike, a chain links the crank through the chain rings, to the sprockets on the rear wheel. As the rider pedals the crank, the chain moves, causing the sprockets attached to the rear wheel to rotate, and the bike to move.

When you ride your bicycle up hill, you use the smaller chain ring and the largest sprocket to minimise the amount of effort it will take to turn the rear wheel. It is easier to pedal a small chain ring than a large ring!



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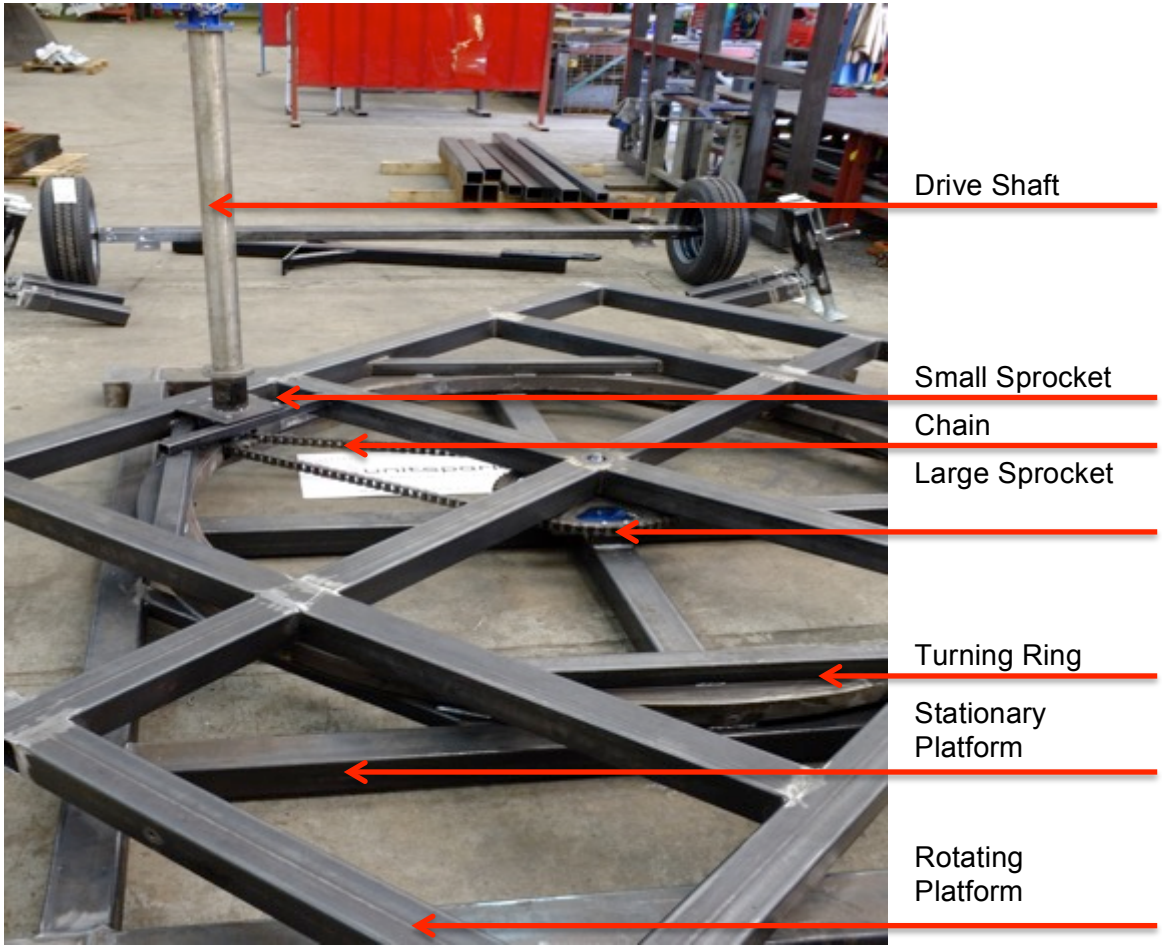
In The Observatory, a crank handle acts like the small chain ring on a pushbike, which requires less effort to rotate the heavy Observatory structure. The Observatory crank handle is attached to a Drive Shaft that carries the turning motion down to the Small Sprocket (where the small chain ring on a bicycle would be), and a chain to the Large Sprocket (where the rear wheel would be on a bicycle). The Large Sprocket was mounted in the middle of the Stationary Platform and the Small Sprocket in the corner of the Rotating Platform.



Two identical, large box section steel frames were made. Because the weight of The Observatory on top of the frames, a single shaft turning mechanism in the middle of the frame would not be sufficient to turn the structures safely or prevent them from tipping over. A large Turning Ring with small wheels called bearings, was placed in the biggest circle that could be fit into the frames. This supports and spread sthe weight of the structures, allowing for full and safe 360 degree rotation; just like the turret on a tank.

Artist Simon Ryder using the crank handle (wheel) to rotate the Observatory. The Drive Shaft can be seen below the wheel.

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Craning

The Observatory has to be moved by road between sites. In order to do this the structures are lifted using a crane, onto the back of a flat bed lorry.

Imagine a puppet on strings. If there were no wooden bars at the top of the strings to keep the strings separate, the puppet would always get tangled up. In order to lift The Observatory, lifting chains were attached to the base at four separate points. The chains were then connected to lifting bars to prevent them from getting tangled, or damaging the structures during craning.

A special, lowered flatbed lorry was used to transport The Observatory. The lowered lorry allowed the height of The Observatory to pass safely under motorway bridges as it made its way to site.

Transportation

The Observatory has to be safely transported to 4 different locations, so the steel base designed by the engineers at Unitspark had to be easily transportable.

The sites vary from grassy fields to the banks of a marsh. The types of ground at each site were examined, as were the kinds of vehicles that could cross this ground, for example a tractor.

The steel bases were built into a trailer with a detachable axel or wheel for each corner at one end, and a hitch at the centre of the other end; a bit like a caravan. The axel/wheel is simply attached to the steel base and the whole thing is then hitched to the vehicle that will pull the structures.