Architecture meets Nature

Creative Learning
Teacher Resource

Architecture meets Nature
Notes for Teachers

In this creative workshop students will learn how to create their own natural buildings using recycled and sustainable materials, taking inspiration from the ingenuity of the natural world.

The workshops can be delivered alongside a tour of the House exploring First Nations perspectives, the architectural practice of Jørn Utzon and his collaborators, as well as the contemporary uses of the site as a world-class performing arts venue.

The following Creative Learning Notes contain video links and suggested activities to build on an excursion to *Architecture meets Nature* in the Centre for Creativity.

We recommend using this resource as a starting point, to adapt content in a way that suits the learning needs of your students.

Architecture meets Nature
Workshop Overview

Designed by the Danish architect Jørn Utzon, the Sydney Opera House is a unique and innovative design representing a breakthrough in modern architecture. Utzon was inspired by the ingenuity of the natural world to inform his design – evoking Sydney's cliffs, the wingspan of birds and the sails of boats on Sydney Harbour.

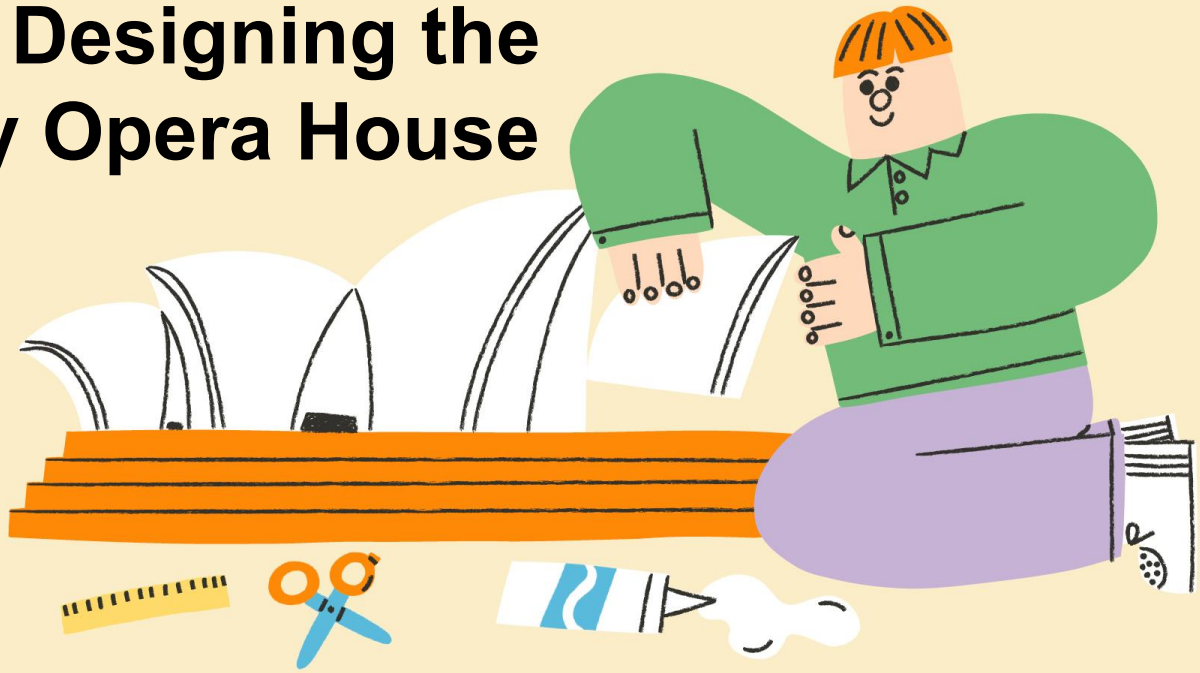
Climate change is demanding that we find new ways to build our cities, so learning from nature has never been more important. Utzon had a passion for nature, and was a keen observer, translating it creatively to his designs. Students will embrace this design thinking as they consider what lessons can be learned from nature.

Architecture meets Nature

In this workshop, students will:

- Learn about Jørn Utzon, his love of nature and how the Sydney Opera House was built.
- Be inspired by the natural world through the Utzon Design Principles of biomimicry.
- Consider sustainability and the built environment by creating artworks (and cities!) that work with nature and a changing climate.
- Build design thinking skills by using elements and principles of design to create experimental architectural forms.

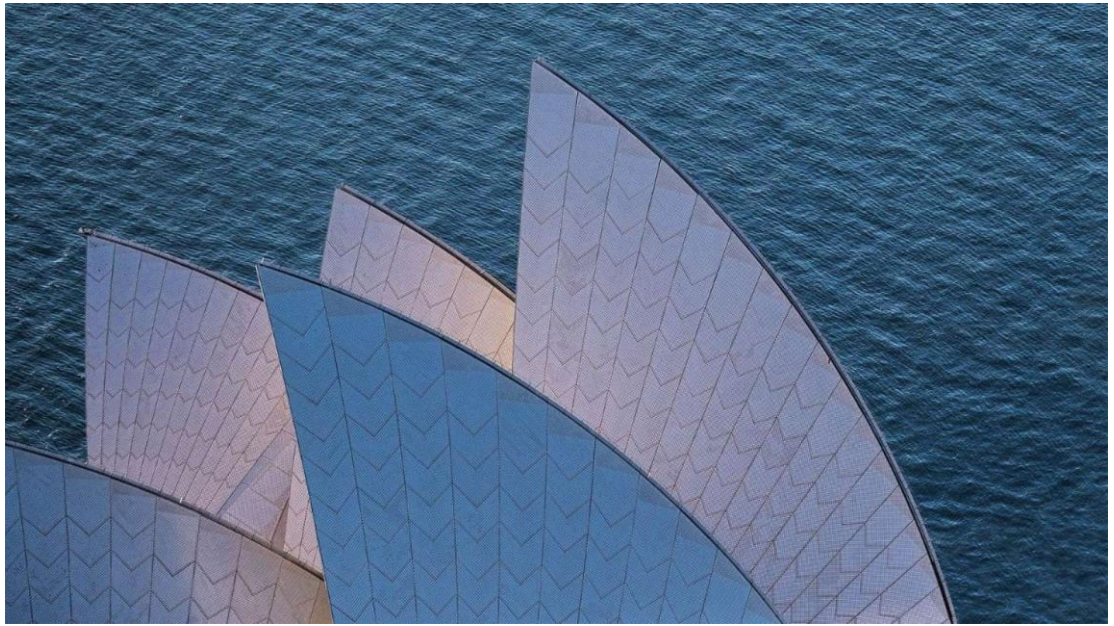
Designing the Sydney Opera House



The Sydney Opera House was designed for performing arts and cultural experiences

The Opera House is a World Heritage-listed masterpiece of ‘human creative genius’ that belongs to all Australians.

It is the Country’s number one tourist destination and its busiest performing arts centre, welcoming more than 10.9 million visitors a year on site and hosting more than 1,800 performances attended by more than 1.4 million people.

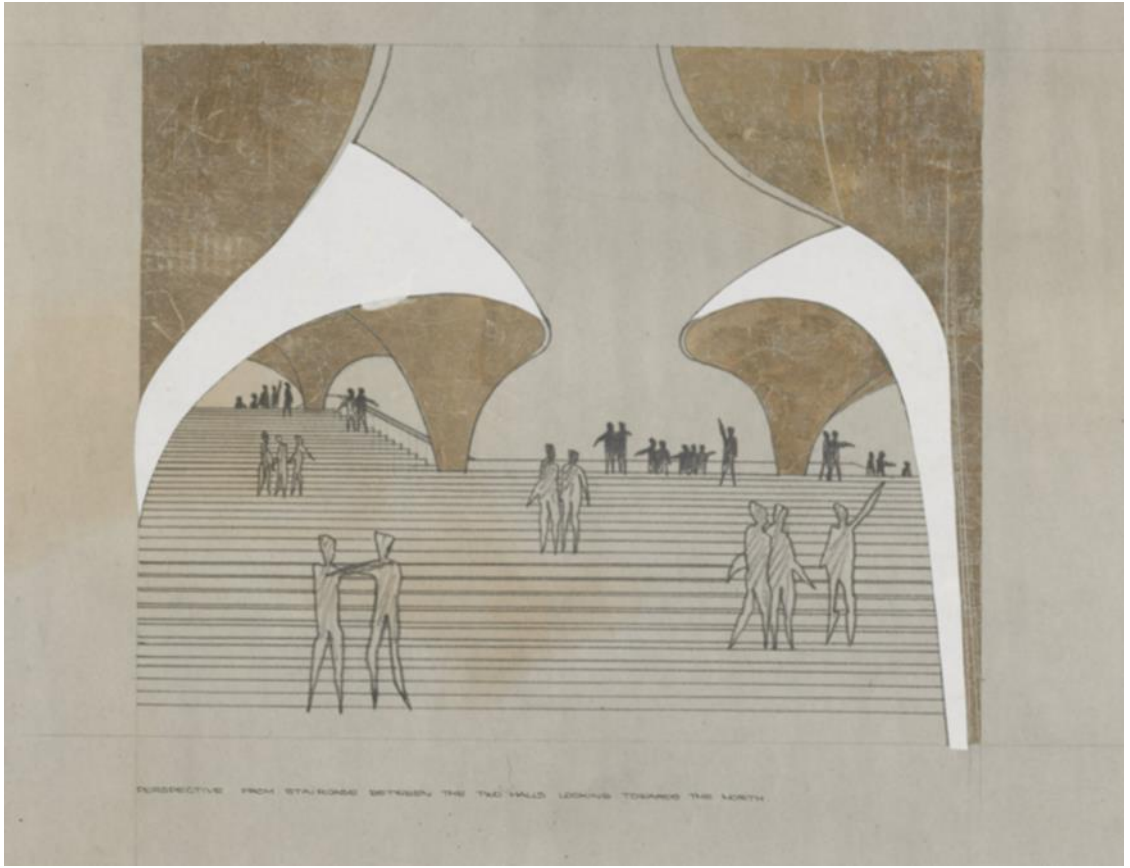


Jørn Utzon is a Danish architect who designed the Opera House

His design was received in 1957, there were 223 entries from 28 countries.

Utzon was announced the winner, receiving £5,000 for his design. His drawing presented an idea in a unique and unconventional way, and used gold leaf, pencil and white paper.

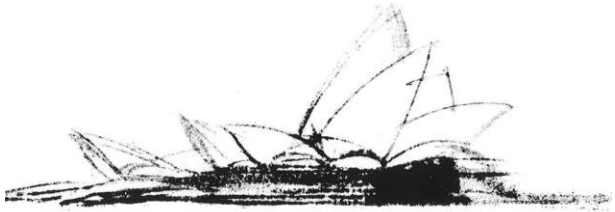
The Opera House was completed and opened in October 1973.

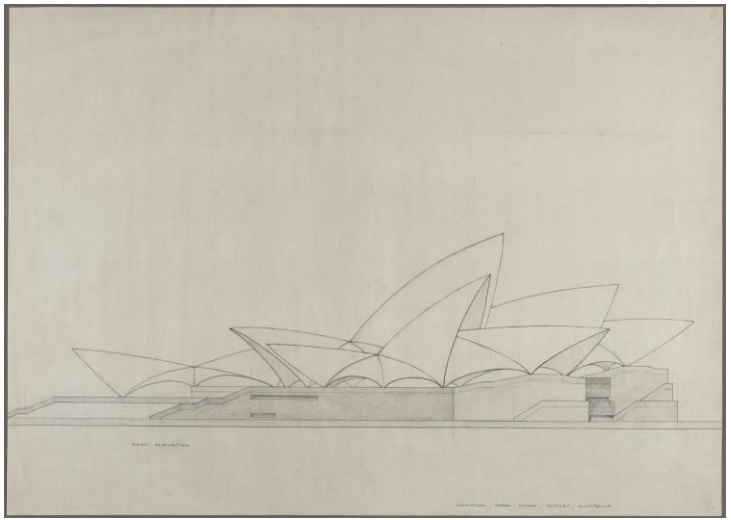


Utzon and nature

Jorn Utzon observed nature and took his inspiration from it. He travelled to many places and saw lots of different landscapes. In particular, he loved the water and clouds and wanted the Opera House to feel like the sea (and land) was connected to the sky.

You can see the evolution of this design thinking in Utzon's drawings below. Two are quick sketches and one is technical drawing.





Teaching points:
A glossary of built environment roles and careers

- **Architect:** someone who designs buildings and communicates their ideas with sketches, technical drawings (hand-drawn or using computer aided software) as well as models and prototypes.
- **Engineer:** someone who uses design processes to solve technical problems, improve systems of working and increase how efficiently something can be produced – like a machine or structure.
- **Builder:** a person who has technical knowledge of a range of materials and uses these to construct buildings or other structures
- **Project Manager:** a person who makes sure big projects (like building the Opera House) can stay within budget, makes sure certain standards are achieved and that projects meet their deadlines.

A comprehensive sustainable buildings glossary can be found here

Teaching point: ask students to list what skills, knowledge and interests they have that might align with the different roles listed here.

- Put students in groups with different abilities and ask them to discuss how they might need to collaborate or compromise when working together to develop a design.

Biomimicry in design

What is biomimicry?

Very simply, biomimicry means to copy nature.

For designers and architects this might be using or copying the patterns, colours and textures of natural environments in their buildings. The drawing on the left is Jorn Utzon's sketch of organic (rounded) shapes to work through how to build the iconic roof of the Opera House.

Another term for this is **biophilic design**. This approach aims to create the best conditions for people to live in and use buildings – it has minimal impact on the environment, is inspired by the beauty of the natural world and can be a more sustainable way of designing and building cities.

What is a pavilion?

A pavilion is a light-weight, usually open building, used for shelter and relaxing or for concerts and exhibitions. It is usually a temporary structure, adding on to an existing building or any public space.

Because they are smaller and temporary, unlike a permanent building, pavilions allow architects to experiment with materials and ideas that might inspire cities and buildings to be more interesting and unusual.

Teaching point: research architectural pavilions around the world – What makes them unique? What materials are used? Why did the architect make them?

The Spherical Solution is the name of the mathematical and engineering principle used to help build the roof of the Opera House

To work out how to build the shells, the engineers at Arup & Partners needed to express the shell shapes mathematically. Asked by the engineers in 1958 to define the curves of the roof, Utzon took a plastic ruler, bent it against a table and simply traced the curves.

A sphere has a single, constant form which can be simply and easily repeated, which are the ‘sail’ or ‘shell’ shapes of the final roof design.

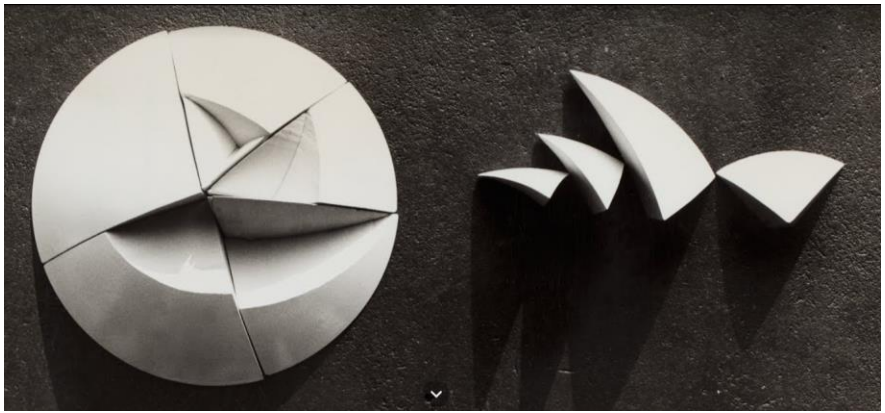
This drawing by Jorn Utzon shows the thinking behind the development of how this design solution was created – and how the natural world and organic forms can inspire building design

The Spherical Solution as a three-dimensional model

This is where the popular myths comes from – that Utzon was inspired to use a sphere when he had a eureka moment while peeling an orange – it perfectly described the thin shell structure of the roof.

By finding the parts of a sphere that best suited the existing shapes of the shells, each new form could be extracted.

Teaching point: Learn more about the types of physical and digital models created for the Sydney Opera House here.



Curriculum connections and further research

Curriculum Links
Connecting with the classroom

Mathematics

- MA2-PF-01: represents and compares halves, quarters, thirds and fifths as lengths on a number line and their related fractions formed by halving (eighths, sixths and tenths)
- MA2-GM-01: uses grid maps and directional language to locate positions and follow routes
- MA2-GM-02: measures and estimates lengths in metres, centimetres and millimetres
- MA2-2DS-01: compares two-dimensional shapes and describes their features
- MA2-3DS-01: makes and sketches models and nets of three-dimensional objects including prisms and pyramids
- MA3-2DS-01: investigates and classifies two-dimensional shapes, including triangles and quadrilaterals based on their properties
- MA3-3DS-01: visualises, sketches and constructs three-dimensional objects, including prisms and pyramids, making connections to two-dimensional representations

Science and Technology

- ST2-DDT-01: uses a design process to create products to address user needs or opportunities and assesses their individual and collaborative skills for learning
- ST3-DDT-01: uses design processes to create, evaluate and modify designed solutions

Curriculum Links
Connecting with the classroom

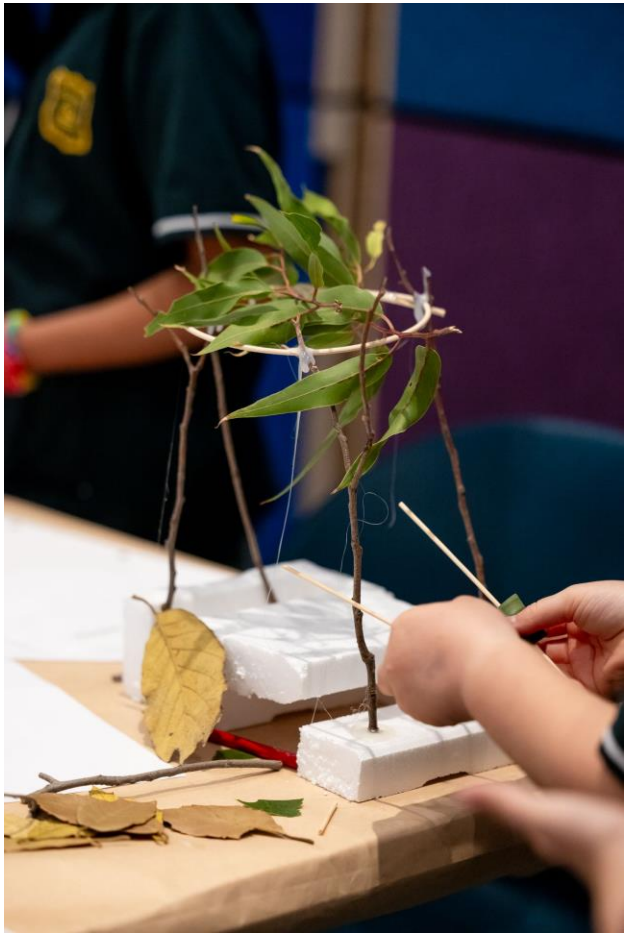
Human Society and it's Environment

– HS2-GEO-01: explains how people care for Australia's environments and participate in Australian society, using geographical information

Creative Arts (Visual Arts)

– CA2-VIS-01: makes artworks using art forms to represent subject matter and ideas, and describes ways artists convey ideas about their world to audiences through artworks

– CA3-VIS-01: makes artworks in intentional ways to represent ideas about their world, and explains ways artists are influenced by contexts and how artworks are interpreted by audiences



Resources
More about the Sydney Opera House

Sydney Opera House: Our Story
- https://www.sydneyoperahouse.com/our-story

How we work – strategic plans and programs
- https://www.sydneyoperahouse.com/about-us/how-we-work

Community projects
- https://www.sydneyoperahouse.com/about-us/in-the-community

Careers and opportunities
- https://www.sydneyoperahouse.com/about-us/careers-and-other-opportunities

Creative Learning resources
- https://www.sydneyoperahouse.com/learn/teachers-and-students/classroom-resources

Get in touch

Got questions? Contact us with any enquiries about our education programs for schools via phone or email.

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