# Sustainable construction and biomimicry

## Further Education – Construction

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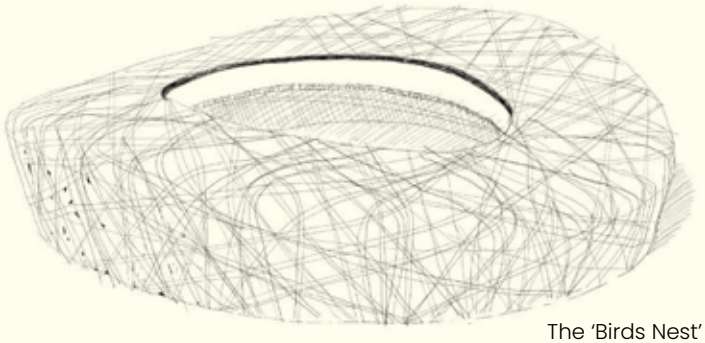
## Specialist knowledge for teachers

Our lesson Biomimicry and Construction engages students in learning practical skills and building an emotional connection with the ecologies of their surroundings. The plan is targeted at 16–18-year-old students, particularly in the construction sector, embodying an interdisciplinary approach that ties local natural phenomena to sustainable building practice. It explores the environmental and ecological features of Morecambe Bay using Biomimicry as a framework for learning, fostering a sense of place and purpose among students.



The 'Birds Nest' Beijing Olympic Stadium.

### Integration of Local Ecology and Construction Techniques

Morecambe Bay, known for its rich biodiversity and distinctive landscapes, provides a perfect backdrop for lessons in biomimicry. The curriculum involves students engaging directly with local ecology - such as the habitats of the Common Starling and the Reed Warbler, and the intricate structures of the Common Orb Spider's webs—to inspire sustainable design. This place-based learning approach not only teaches students about biology and ecology, but also about optimising materials and structural designs that are both innovative and environmentally sensitive.

The Common Orb 'Garden' Spider and web.

### New Knowledge for Educators

To effectively deliver these lessons, educators will equip themselves with a broad spectrum of knowledge on biomimicry and evolution. Firstly, a good understanding of the specific species of Morecambe Bay is important - knowing why and how these species adapted to their particular niche helps to translate biological strategies into engineering solutions. For instance, educators should begin to understand the material properties and design principles behind the durability and flexibility of bird nest construction.

Secondly, knowledge of sustainable construction practice is important. This includes familiarity with retrofitting buildings to enhance energy efficiency, understanding the principles of using sustainable materials, and knowing contemporary construction techniques that minimise environmental impact. Educators should integrate these principles with biomimetic designs inspired by local fauna.

# Examples in practice

01 Introduction

02 Talk and discussion: Biomimicry: Morecambe Bay, The Eden Project and Common Construction Principles

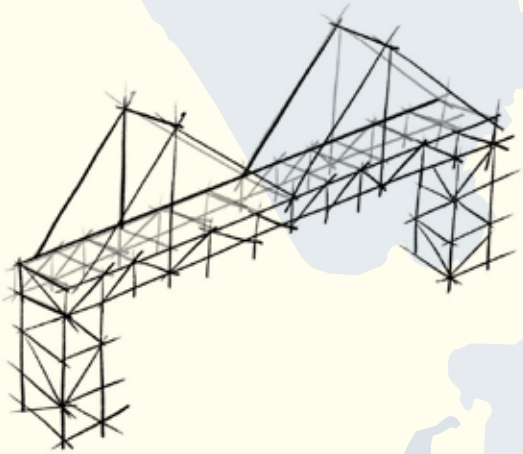
03 Talk and discussion: Sustainable Construction: Optimisation of Materials, Retrofitting and Material Passports

04 Testing and Evaluation: Measuring to assess tallest, strongest and most robust structures

05 Conclusion and Review: Including student evaluation of the activities

# Activities

## 1 Bridge Building



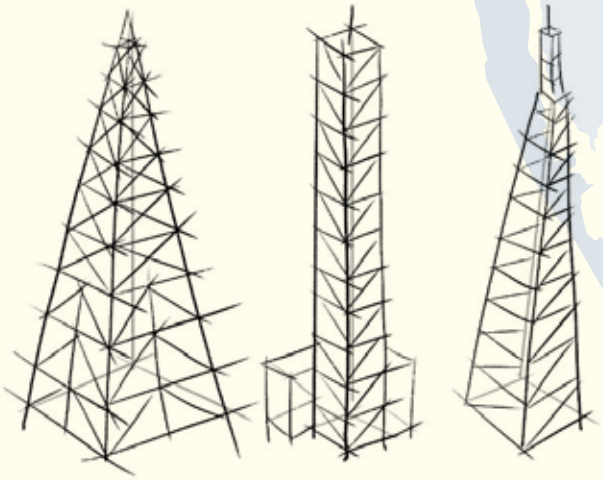
Construct a bridge to carry a heavy weight, spanning a set distance, using the least amount of material that you can! You should consider your design approach in relation to the bone structure and habitat of species discussed in our talk.

The bridge that can take the heaviest weight using the least amount of material wins! If your bridge breaks under the weight, think about where it failed and what you can do to improve the design next time.

Required materials: Spaghetti and masking tape

Time for activity: 30 minutes

## 2 Tower Building



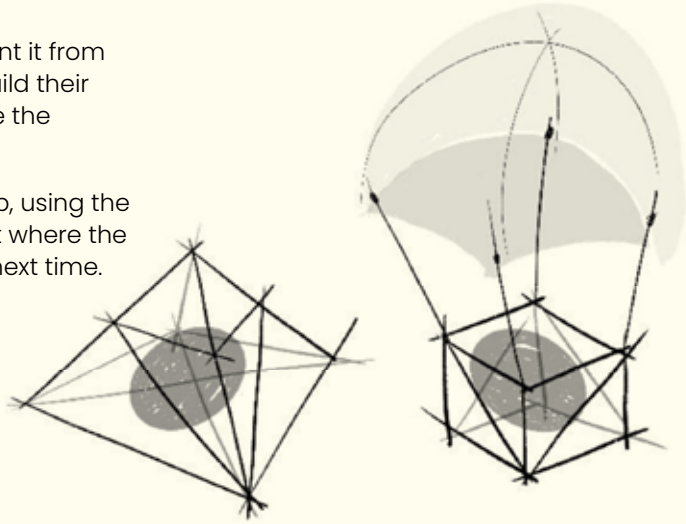
You must build the tallest free-standing tower you are able to in teams. Competing against each other in groups, you should design and construct towers out of as few pieces of spaghetti and tape as possible and position your marshmallow as high up from the floor as possible!

You can take your inspiration from biomimicry concepts and examples shown in the talk. At the end of the activity, the team with the tallest marshmallow, which can stand without support, using the least amount of materials wins.

Required materials: Spaghetti, masking tape and marshmallows

Time for activity: 30 minutes

## 3 Egg Protection



Use your knowledge of structures to protect an egg and prevent it from breaking when dropped from height! Think about how birds build their nests and investigate how flexibility as well as rigidity can solve the problem of protection.

The design that protects the egg from the greatest height drop, using the least materials, wins! If your design breaks the egg, think about where the structure failed and what you can do to improve your design next time.

Resources: Spaghetti, masking tape, paper, eggs

Time for activity: 30 minutes

# Curriculum aims and objectives

Biomimicry and Architecture is targeted at further education students; these can be students as young as 14 but are typically ages 16-18 with some mature learners present. The activities combine the Head and Hands approach present in a construction department, adding the Heart dimension as a new way of engaging with the built environment and connecting with the places in which we live.

## Through two interactive lectures and three practical exercises, we aim that students will:

- Understand how local Morecambe species optimise their use of local materials to build habitats
- Understand concepts of biomimicry and how nature inspired design can solve engineering challenges
- Work together as teams to find solutions to shared problems
- Develop problem solving skills to build the tallest towers, longest bridges and protective nests with minimal materials, mimicking nature's protective mechanisms
- Incorporate a place-based learning approach, taking influence from local landmarks such as The Eden Project and Blackpool Tower
- Explore principles of material reuse including the use of material passports to reduce carbon expenditure and improve sustainability

## With Key Learning Outcome

- To empower learners to invest emotionally in the environment by reducing waste material in their projects by learning from nature

Throughout the project, learners will be investigating the local natural environment to identify challenges and opportunities for sustainable construction practices with the intention of giving them a new outlook on the environment, the local area, and the influence that they can have in the sector.

## Head

Students will expand their knowledge of how local species construct habitats and link this to what the know about the built environment, thus developing understanding of biomimicry. They will also consider how the reuse of building materials can help to reduce the carbon footprints of new construction projects.

## Heart

By encouraging students to engage with and take notice of the ecology of their natural surroundings, they will be able to build a personal and emotional connection with their environments. By examining close details, they will be able to appreciate the wonder of nature.

## Hands

The activities offer the chance to apply their knowledge in hands-on problem-solving tasks, working in teams to put their understanding of architectural principles into practice.

The Reed Warbler and nest

# Adaptations to extend impact

## Linking Knowledge to Place

The project's core learning philosophy—connecting knowledge to place—helps students understand the relevance of what they are learning through tangible, local examples. By studying how the Common Starling constructs its nest to withstand impacts at height, students can actively create a structural model that offers similar properties for shock-absorbent structures in construction. Similarly, examining the span of the Common Orb Spider's web can lead to discussions on tension and weight distribution in bridge building. Although these are aimed at construction students, the activities could be adapted to suit different age phases, particularly secondary Design and Technology or engineering students.

This approach not only enriches the students' learning experience but also ingrains a strong sense of stewardship for the local environment. It encourages students to think critically about how construction impacts ecological systems and how these systems can inform smarter, sustainable construction practices.

Educators, equipped with detailed ecological, biological, and constructional knowledge, are pivotal in guiding students through this learning journey. This project exemplifies how education can transform the heart by engaging the head and the hands in meaningful, context-rooted learning.