



FOCUS QUESTIONS

- In what ways does bringing plant biodiversity into city spaces also help restore and conserve animal biodiversity?
- What are the basic design requirements for an architectural system that can support a vertical plant community?
- A bio-inspired design is a concept, approach, or technology that shares both structure and function with nature. How is a vertical meadow an example of a bio-inspired design?

OVERVIEW

“We need to think of new ways to bring nature into the urban space.” -Alistair Law

Vertical Meadows tells the story of how a building facade engineer, Alistair Law, has designed a way to literally bolt nature onto our existing city buildings but also onto the scaffolding systems we use in building restoration and new building construction. Law’s design includes regionally sourced native grassland and meadow plants that grow from seeds directly on his vertical systems. We learn that because the plants are native, they track the seasons and provide steppingstones and corridors throughout the urban landscape of food and shelter for resident and migratory birds and insects. Law has also partnered with biologists to study how his systems are benefitting these local animal communities.

KEY CONCEPTS

- **Habitat loss:** Since 1930 97% of the United Kingdom’s wildflower meadows have been lost to agriculture and urban development. For some perspective, 62% of North America’s grassland ecosystems have been converted to other uses like agriculture and urban development.
- **Biodiversity:** The International Union for the Conservation of Nature lists more than 44,000 species threatened with extinction and agriculture is the major threat for more than half of these species. Installing vertical meadows of native plants in cities can help mitigate the biodiversity threats.
- **Conservation biology:** The practice of conservation biology recognizes the intrinsic value of the Earth’s natural diversity of organisms. Conservation biology works to understand how the natural world operates, how humans affect nature, and how we can use collective scientific and cultural knowledge to conserve Earth’s biological diversity.
- **Bio-inspired design:** Environmentally-minded engineers are developing concepts, approaches, and technologies that share both function and structure with nature. Vertical meadows can be nearly as diverse in plant life and ecosystem function as a traditional meadow or grassland.

BACKGROUND

The idea of the vertical garden was first patented in 1938 by University of Illinois (Urbana-Champaign, USA) Landscape Architecture professor, Stanley Hart White. Hart’s patent describes a method for creating an ‘architectonic structure of any buildable size, shape or height, whose visible or exposed surfaces may present a permanently growing covering of vegetation’. Hart’s patent contains drawings of what he describes as a coarse rust-proof wire mesh frame filled with natural fibers within which plants can root and which contains irrigation and drainage. Hart describes his invention as able to be free-standing or affixed vertically either permanently or temporarily to a wall for the purpose of creating “decorative backgrounds or screens for masking eyesores or for concealing people or properties.”



Unfortunately, Hart's original idea and designs never made it beyond those he constructed on his property in Urbana, Illinois. Fortunately, 50 years later, in 1988, French plant biologist Patrick Blanc used his training and research on how plants adapt to extreme environments and filed a patent application for his own version of the vertical garden that he called a "device for growing plants without soil on a vertical surface." Blanc's design, which he called a plant wall, includes a metal frame covered with a waterproof layer of polyvinyl chloride (PVC) and felt. Blanc also worked an automated irrigation system into his design and has since been hired to design and install his "botanical tapestries" all over the world. In the **Vertical Meadows** short film, we meet Alistair Law, Founder and CEO of Vertical Meadow.

In 2012 Law became interested in joining the burgeoning green wall movement but with an important innovation that could help mitigate the effects of Great Britain's lost prairie habitats. Law had as a primary goal helping reverse the loss of 97% of the United Kingdom's wildflower meadows over the last century so he invented and patented a mat system that is pre-seeded with native wildflower seeds. The mat systems are attached to scaffoldings with integrated irrigation which in turn are mounted on buildings and thus grow wildflower meadows vertically. Law has also designed a meadow cladding system that can be installed permanently on building facades. The vertical meadow systems bring this dwindling yet important UK ecosystem into the urban environment where the wildflowers not only beautify the cityscapes but also provide food for important pollinator species like bees while increasing habitat for other insects like butterflies as well as birds. Law has teamed up with landowner Donald Macintyre who grows over 50 different species of native wildflowers on his land. Macintyre provides the wildflower seeds used in the Vertical Meadow mats. Law also works with biologist Scarlett Weston of BugLife who monitors which bees visit the vertical meadows. Weston studies how the Vertical Meadow sites are used by the bees and other pollinators as steppingstones across the city. These ingenious meadows are helping to bridge gaps along larger pollinator movement corridors that Weston is establishing across the UK.

BIODIVERSITY THREATS

The major threats to the Earth's biodiversity can be grouped into seven categories that spell the easily recalled acronym H.I.P.P.O.: **H**abitat destruction and fragmentation, **I**ntroduced species, **P**ollution, **P**opulation growth, and **O**verharvesting. Many species are threatened by a combination of these factors, but habitat loss is the greatest threat to biodiversity. In **Vertical Meadows**, we learn that over the last century the United Kingdom has lost 97% of its wildflower meadow and grassland ecosystems and identified the built environment as a major contributor to this loss of biodiversity.

DISCUSSION QUESTIONS

- [Before showing the film] Have students discuss their ideas for bringing regional plant and animal diversity into a crowded cityscape. What plants and animals would be good choices, what characteristics would they need to have, and how would they coexist with the people and the concrete jungle that cities tend to be?
- There are dozens of patented methods for growing plants on vertical planes and each focus on a particular purpose. Most new designs are modifications or improvements on past designs. After watching the film, have student teams create an annotated sketch of Alistair Law's vertical meadow. Then have students design a new modification to Law's design and present their idea to the class.
- A bio-inspired design is a concept, approach, or technology that shares both structure and function with nature. Generate a list with students that includes examples of bio-inspired design? What makes for a successful design? An unsuccessful design?



CURRICULUM CONNECTIONS

NGSS

HS-LS2 Ecosystems: Interactions, Energy, and Dynamics

- LS2.A: Interdependent Relationships in Ecosystems
- LS2.B: Cycles of Matter and Energy Transfer in Ecosystems
- LS2.C: Ecosystem Dynamics, Functioning, and Resilience
- LS4.D: Biodiversity and Humans

HS-LS4 Biological Evolution: Unity and Diversity

- LS4.C: Adaptation

ETS1.B: Developing Possible Solutions

AP Biology (2021)

Enduring Understandings

- Energetics (ENE)
 - ENE-4: Communities and ecosystems change on the basis of interactions among populations and disruptions to the environment.
- Information Storage and Transmission (IST)
 - IST-5: Transmission of information results in changes within and between biological systems.
- Systems Interactions (SYI)
 - SYI-1: Living systems are organized in a hierarchy of structural levels that interact.
 - SYI-3: Naturally occurring diversity among and between components within biological systems affects interactions with the environment.

IB Biology (First Exam May 2025)

A. Unity and Diversity: Common ancestry has given living organisms many shared features while evolution has resulted in the rich biodiversity of life on Earth.

- A1.1 Water
- A3.1 Diversity of organisms
- A4.2 Conservation of biodiversity

B. Form and Function: Adaptations are forms that correspond to function. These adaptations persist from generation to generation because they increase the chances of survival.

- B4.1 Adaptation to environment
- B4.2 Ecological niches

C. Interaction and Interdependence: Systems are based on interactions, interdependence and integration of components. Systems result in emergence of new properties at each level of biological organization.

- C1.3 Photosynthesis
- C4.1 Populations and communities
- C4.2 Transfers of energy and matter

D. Continuity and Change: Living things have mechanisms for maintaining equilibrium and for bringing about transformation. Environmental change is a driver of evolution by natural selection.

- D4.2 Stability and change
- D4.3 Climate change

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CREDITS

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