TEACHING BY DESIGN

FRANK LLOYD WRIGHT TRUST

BIOMIMICRY IN DESIGN

GRADE: 4-12
TIME: Three 45-minute sessions

Biomimicry is the design and production of materials, structures, and systems that are modeled on biological entities and processes. In this lesson, students will draw inspiration from biomimicry and organic architecture to design and build architectural models that reflect the forms and processes of organisms, ecosystems, and habitats found in the natural world. Through this lesson, students will build research skills as they learn how processes and forms in nature can creatively be applied to design.

INTEGRATED SUBJECTS: Visual Arts, Science

MATERIALS | RESOURCES

Paper and/or cardstock (various colors)
Tape and/or glue
Scissors
Rulers or a straight edge
Photos showing examples of organic and biomimetic architecture (Appendix A)
Library or Internet access for independent student research
Optional: Research Sheet (Appendix B)

OBJECTIVES

1. Understand the concept of biomimicry and its relationship to sustainable design.
2. Understand how Frank Lloyd Wright creatively mimicked forms and processes found in nature.
3. Develop research questions to better understand the natural world, and collaboratively research an organism, ecosystem, or habitat found in the natural world.
4. Apply their research and understanding of the natural world to the design of a building.
5. Create an architectural design of art that utilizes the concept of biomimicry.

ESSENTIAL QUESTIONS

1. How can imitation be creative?
2. What role does research play in design and innovation?
3. How can the forms and functions of nature inspire sustainable designs?
4. How is Wright's concept of organic architecture related to nature?

LESSON PROCEDURE

[redacted] EXPLORE

Session One

- **Introduce students to the concept of biomimicry, or the use of nature as a model and teacher in design. Support with examples of biomimetic designs, such as Velcro or Japanese bullet trains.**
- **Discuss how nature influenced the form and function of these designs. Ask:** Was form or function a more important influence? How are the two related? What differences can you see between the design and the natural element that inspired it?
- **Introduce students to the work of Frank Lloyd Wright and the architect's philosophy of organic design. Support with photographs of the Frederick C. Robie House (1910), Wright's most famous Prairie style building. Ask:** How did Wright design in harmony with nature? How is this building inspired by the prairie landscape?
    - If students are unfamiliar with prairies, spend some time with students learning about prairie landscapes and their biodiversity. When discussing the Robie House's connection to the prairie, be sure to highlight visual relationships (emphasis on horizontality) and functional similarities (Wright's innovative use of passive heating mimics the way taller native prairie plants provide shade for smaller plants).
    - Show the front-side of Appendix A to discuss other examples of Wright's organic architecture.
- **Explain that even though Wright mimicked nature, his designs were incredibly innovative. Wright was designing biomimetic designs before the term "biomimicry" existed and he pioneered a completely new style of architecture—the Prairie style—an example of biomimicry.**

[redacted] ENGAGE

Session One

- **Introduce design challenge: students will design a biomimetic building. Consider identifying a specific building for students to create with a specific design challenge to solve. Visit AskNature.org's Bio-Inspiration Cards, for prompt ideas (https://asknature.org/resource/asknature-bio-inspiration-cards/.)**
- **Assign a natural element to small groups for further research. Examples could include: pangolins, beavers, prairie dogs, termites, mussels, rainforest trees, or wetlands.**
- **Ask:** What do you wonder about your organism, ecosystem, or habitat? What do you need to better understand?
- **In small groups, ask students to develop a set of research questions that will help them better explore and understand the assigned topic. If using Research Sheet (Appendix B), direct students to complete the "Before Research" section.**

[redacted] EXPLORE

Session Two

- **Review biomimicry and introduce contemporary examples of biomimetic architecture such as Mike Pearce's Eastgate Center (1996) or Santiago Calatrava's Milwaukee Museum of Art (2001).**
- **Show the back-side of Appendix A to discuss other exmaples of biomimetic architecture.**
- **Have small groups share questions they intend to research with the rest of the class.**

LESSON PROCEDURE *(continued)*

ENGAGE

Session Two

- Have small groups divide research questions identified in Session 1 amongst group members.
- Ask students to independently use the internet or library materials to research their assigned questions. Encourage students to vist AskNature.org (https://asknature.org/).
- Have students record their findings, as well as any new questions that arise during research. If time allows, students can begin researching any new questions that arise.
- Ask students to sketch their assigned natural element. Ask: What shapes, lines, and colors do you notice? What is unique about the natural element's form? How does the element's form contribute to its function?
- If using Research Sheet (Appendix B), direct students to complete the "During Research" section.
- Have students gather in groups to share findings, observations, and new questions.

DESIGN

Session Two

- Have students independently sketch a few ideas for a building inspired by their natural element. Ask: How is your design inspired by your assigned natural element? How are you incorporating what you have learned about your assigned natural element? Be sure to ask about visual relationships as well as functional similarities.
- If using Research Sheet (Appendix B), direct students to complete the "After Research" section.

CRITIQUE & INTERPRET

Session Three

- Ask students to share and discuss their sketches and ideas with their small group. Instruct students to provide constructive feedback and to take note of similarities and differences in various student designs.

DESIGN

Session Three

- Have students select one of their designs for further revision.
- Once revisions are complete, let students begin constructing their designs with paper, tape, and scissors.

CRITIQUE & INTERPRET

Session Three

- Allow time for students to share and discuss their work with their small group. Students should once again provide constructive feedback and take note of similarities and differences in various student designs.
- Have students make final revisions to their designs, as needed.
- Have students share their design & research processes and present their final designs to the entire classroom. When presenting, students should be challenged to identify how biomimicry and creativity were used in the design.
  - ◊ Optional: Schedule a tour to a local sustainable or biomimetic building to learn how nature influenced its design.

TEACHING BY DESIGN
FRANK LLOYD WRIGHT TRUST

APPENDIX A

NATURE-INSPIRED DESIGNS

Wright's Organic Architecture: Example Images

Frederick C. Robie House (1910)

S.C Johnson Wax Administration Building (1939)

Herbert and Katherine Jacobs Second House, Jacobs II (1948)

TEACHING BY DESIGN
FRANK LLOYD WRIGHT TRUST

APPENDIX A *cont.*

Biomimetic Architecture: Example Images

Milwaukee Art Museum (2001)

Eastgate Center (1996)

Beijing National Stadium (2008)

Name: _____

APPENDIX B

TEACHING BY DESIGN
FRANK LLOYD WRIGHT TRUST

RESEARCH SHEET

Your Natural Element (plant, animal, ecosystem etc.)**:**

Before Research:
What questions do you have about the element?

What would you like to learn about the element's form?

What would you like to learn about the element's function?

During Research:
List Sources:

What did you learn about the element's form?

What did you learn about the element's function?

After Research:
What qualities from the natural element will you imitate in your design?

How can imititating nature be used to problem solve?