

FORM & FUNCTION

GRADE: 3-12

TIME: 3 - 45 minute sessions

How does a designer know which materials to choose for their design? And how do the materials affect the design's form and function? To discover answers to these questions, participants build with Froebel blocks to explore the properties of two- and three-dimensional designs. Then, guided by the design process and scientific method, participants further study, test, and choose the best materials to design and build a three-dimensional structure that will protect a paper figure from wind, light, and water. This lesson is divided into three 45 minute sessions.

INTEGRATED SUBJECTS: Visual Art & Science

OBJECTIVES

MATERIALS | RESOURCES

1 set Froebel Blocks (Gift 3)
1 set Froebel Blocks (Gift 4)
Hair dryer
Small rubber ball or marble
Cup of water
Watering can
Flashlight
Building Materials (Per Group):
Forms of Life & Forms of Beauty Figures
Grids
Popsicle sticks
Metal paper clips
1" square sheets of paper or cardstock
Sugar cubes
A roll of tape
Glue
Paper figure

1. Make connections between Frank Lloyd Wright's design legacy, the design process, and the scientific method.
2. Understand how form and function influence the materials designers choose.
3. Engage in the design process by creating and building 2D and 3D structures.
4. Apply the scientific method to test different structures.
5. Experiment with different materials, re-evaluate choices, and persist in construction.

ESSENTIAL QUESTIONS

1. Can something be both beautiful and useful?
2. How do the properties of materials influence a design?
3. How does a designer think? How does a scientist think?
4. Can a mistake lead to an improved idea?

LESSON PROCEDURE

Session One - Frank Lloyd Wright

EXPLORE

15 minutes

- Introduce the Froebel blocks.
- Demonstrate Froebel's system of building Forms by transforming figures and work through some of the Forms of Life and Beauty for Gifts 3 and 4.
 - To remove the blocks from their box:
 1. Tip the entire box upside down on the grid with the lid closed.
 2. Gently slide the lid out and set aside.
 3. Pull the box up to reveal the stacked blocks inside. Note that this will be the first Form of Life (Figure 10 for Gift 3 & Figure 74 for Gift 4).
- Give participants time to make observations and ask questions about the forms and building process.
- Using the paper figure and a hair dryer, test the strength of the forms on low and high settings, and ask students to suggest reasons why some designs might protect the figure better than others.

ENGAGE

15 minutes

- Divide participants into small groups and distribute group supplies.
- Have each group explore the various materials and record their observations on a sheet of paper.
- At the same time, circulate the Froebel Blocks so that each group has time to explore and manipulate the blocks.
- Have each group discuss how the different supplies are similar to and different from the Froebel Blocks.
Consider:
 1. Can you build any of the Forms of Life or Forms of Beauty using these new materials?
 2. Which materials seem to work best to build the forms, and why?

CRITIQUE & INTERPRET

15 minutes

- Have each group organize and gather their materials together in the center of their table or desk.
- Introduce Frank Lloyd Wright, his Home & Studio in Oak Park, and the Frederick C. Robie House in Chicago's Hyde Park. Explain that Frank Lloyd Wright played with Froebel blocks as a child and said they inspired him as an architect. (<https://www.teachingbydesign.org/about/frank-lloyd-wright/>)
- Begin a discussion of the forms and materials Frank Lloyd Wright used. Ask:
 1. What shapes do you see?
 2. Do you recognize any of the structures and patterns we saw with the Froebel Blocks?
 3. Why might Frank Lloyd Wright have chosen the shapes and materials that he used?
 - i. Do some blend into nature better than others?
 - ii. Do some look more resistant to rain, wind, or sun?
 4. How do the materials that Wright used compare to the materials on your desk?
- Note that Frank Lloyd Wright did not always choose the best shapes and materials for his first or even his final designs because he was frequently trying something new. Ask participants to consider briefly how an architect that made mistakes could become famous.
- Encourage participants to continue thinking about answers to these questions as they will be designing, building, and testing their own structures next. Pose the design problem for them to consider:

"Using only the materials at your table, design and build a model that protects the paper figure inside from wind, rain, and sunlight. The completed design must incorporate one Form of Life and one Form of Beauty."

LESSON PROCEDURE

Session Two - Design & Experiment

EXPLORE

5 minutes

- **Remind participants of the design problem.**

"Using only the materials at your table, design and build a model that protects the paper figure inside from wind, rain, and sunlight. The completed design must incorporate one Form of Life and one Form of Beauty."

- **As a group, begin brainstorming some solutions and strategies a designer might use and that they may want to try.**
- **Ask participants if any of their strategies remind them of another process that they use to conduct experiments.**
- **Briefly review the scientific method and draw comparisons to the design process.**
- **As a group or class, define a scientific question that mirrors the design problem.**

"What materials (popsicle sticks, paper clips, paper, sugar cubes, tape, and glue), or combination of, will best resist wind, water, and light to protect the person inside?"

ENGAGE

20 minutes

- **Have participants divide into their smaller groups and distribute a sample of each of the building materials.**
- **Have each group conduct background research by exploring and testing the various properties of each of the building materials. To record their findings, have participants complete the Properties worksheet (attached at end of lesson). Each different material should be tested with the cup of water, hair dryer, and flashlight.**
- **Once research and testing has been completed, have each group develop a hypothesis for which materials and Forms will create the strongest structure.**

DESIGN

20 minutes

- **Using their research and hypothesis, have each group briefly sketch their initial design.**
- **Allow participants to work collaboratively in their groups to construct their structure. Remind groups to refer to their notes and background research as they build.**
- **Allow time for students to reevaluate and adjust designs as they build, reminding them that even Frank Lloyd Wright didn't always get it right the first time.**

LESSON PROCEDURE

Session Three - Test & Evaluate

EXPLORE

10 minutes

- Arrange the completed structures on tables or desks, and have participants do a museum walk around the room to see the different designs and solutions.
- Have participants return to their seats and begin a discussion about their observations. Ask:
 1. What did you observe?
 2. What Forms did you recognize?
 3. How did different groups use the building materials? Was this different than the way you used them?

ENGAGE

20 minutes

- Together as a large group, test each design to determine which one is most successful in protecting the paper figure from water, wind, and light. Ask students to record their observations for each group in the Form and Function worksheet (attached at end of lesson).

CRITIQUE & INTERPRET

15 minutes

- After each design has been tested, allow participants to review the results in their groups and determine which design is most successful.
- Cast a vote. Ask:
 - FUNCTION: Which design best succeeded in protecting the figure?
 - FORM: Which design did the best job of incorporating a Form of Life and Form of Beauty?
- Finally, allow time for students to reconsider new solutions. Ask:
 1. What might they borrow from another group's design to improve their own?
 2. What is the relationship between form and function? How might one improve the other?
 3. Can something be both beautiful and useful?

PROPERTIES

Building Materials

1. Describe each material in as much detail as possible.
2. Test each material with the following:
 - Shine the flashlight on each material
 - Use the hairdryer to blow air at each material on low and high settings
 - Use the hairdryer to push the ball toward each material on low and high settings
 - Dip each material in the cup of water

POPSICLE STICK

Transparent

Opaque

Heavy

Flexible

Waterproof

PAPER CLIP

Transparent

Opaque

Heavy

Flexible

Waterproof

PAPER

Transparent

Opaque

Heavy

Flexible

Waterproof

SUGAR CUBE

Transparent

Opaque

Heavy

Flexible

Waterproof

TAPE

Transparent

Opaque

Heavy

Flexible

Waterproof

FORM & FUNCTION

Observe each group's test, and record your observations in the table below. Think about:

1. Does the flashlight let any light in? How much and where? If the flashlight were the sun, would the figure be protected?
2. Does the building move or change when the hairdryer blows air at it? Does the figure inside move?
3. How does the ball make the building move?
4. Does the building change color or texture when water is sprinkled on it?
5. Does the Form of Life help the design protect the figure? Does it make the building more beautiful?
6. Does the Form of Beauty help the design protect the figure? Does it make the building more beautiful?

	FLASHLIGHT	HAIRDRYER	WATER	LIFE	BEAUTY	NOTES
Group 1						
Group 2						
Group 3						
Group 4						
Group 5						
Group 6						