THE NUTS AND BOLTS OF ARCHITECTURE

Fallingwater tours discuss the story of the house, how the family enjoyed it, what Frank Lloyd Wright intended with his architecture at Fallingwater, and how the structure works. Tours are general in scope, but there are some architectural terms that are used to explain the house.

It's helpful to prepare your students first by going over some architectural definitions. Please see the definitions and vocabulary exercises.

Explaining the physics and logic of structural systems can be complicated, but almost any student can understand the basics of structure and architectural design, especially through hands-on investigation. Here are several basic activities that will help your students understand why Fallingwater doesn't fall down.

Materials:

- Blocks
- Books
- Paper
- Foil (optional)

BUILD A CANTILEVER
Give each student at least three blocks or books. Have them hold up one block with the other ones. (Usually a post-and-beam construction results).

Next, ask them to build a diving board, or in other words, a cantilever. Test it with additional weight placed at the end of the free end. (It will fall). Have the students figure out how to prevent this collapse. (By placing blocks on top of the cantilevered block, it will eventually hold the added load. This is the concept of counterbalancing).

BE A CANTILEVER
Choose two students. Ask one to hold a large book in one hand and to extend his/her arm straight out while holding the book. Have the other student hold another copy of the same book on top of his/her head. Wait to see who collapses first.

The student with the book extended will get tired first. This student was acting as a cantilever, trying to resist the forces of tension pulling on his/her arm. Eventually the student could not; the "structure" was not strong enough. The second student was simply holding up the book like a pier or column in a building; the book was pushing down on the student's head. The student was able to resist the pushing, or compressive forces, of the load, and could completely support it

Explain to students the difference between tension (pulling) and compression (pushing). Which student had to fight tension? Which student had to stand tall and resist compression? Explain that the cantilever student had to have much more muscle to hold up the book. Cantilevers must use materials that are strong enough to resist tension; at Fallingwater, that material is steel.

STRUCTURAL FOLDING
Give each student a piece of copy paper and a small block (we use regular size Snickers bars at Fallingwater). Tell the students to

create a structure that will support the block off the table.

Students will eventually determine that they should fold the paper. Folding a slab or material makes it stronger. At Fallingwater, the reinforced concrete is folded for extra strength; the most notable example is the canopy over the walkway.

Students can also understand Wright's concept of the cantilevered concrete trays through another folding exercise. This one works best with a small sheet of aluminum foil, but will work with copy paper, also.

Hold the short end of the paper between your thumb and index finger. Extend the paper out into space without cupping it. You'll notice that the paper sags downward (it deflects). Fold up the four sides of the paper about ½ inch. Now hold the short end, and you'll see that the paper is more rigid. Frank Lloyd Wright felt that by folding up the parapets, he could make the concrete trays or levels of the house more rigid, and more self-supporting.

TIGHTEN YOUR BELT

Have a student tighten his/her belt as tight as possible around their waist. Have the student describe how it feels. The pulling of the belt results in your waist being squeezed. In other words, tension can cause compression.

To repair Fallingwater's deflecting structure, we needed to add compressive strength to the structural beams. In order to do this, we applied tension. A good way to demonstrate this is with a strip of foam rubber, marked with hatch marks about an inch apart, and with waistband elastic attached to the foam rubber. Hold it at one end and demonstrate how it deflects. Then, have a student pull on the loose ends of the elastic while you hold the other end. Students will see the foam rubber compress, the lines will move closer together, and the strip of foam rubber will straighten.