LEARNING LYNX | Building Architectural Awareness

Students will learn how to calculate the golden ratio from a Fibiocci Sequence as well as how to calculate dimensions with a given ratio.

Students will critically examine an urban planning issue in their community.

Students will explore the impact of geometry on design strength.

LEARNING LYNX: BUILDING ARCHITECTURAL AWARENESS

In this lesson you will hone your visual senses and develop strong critical thinking skills as you explore the world of architecture through time and space. Architecture is the science and art of planning, designing, and building buildings and other structures. In Career Lynx, you will learn about the many professionals that work together to make this happen. Here, you will learn why architecture is so important to our society on a global, national, and local scale. You will have the opportunity to consider history, social studies, science, math, and art as you explore the field.

Building Background: Use the space below to draw your favorite building or structure. Label the drawing with the features of this building that you value as important to you.

Values of Architecture:

Values are deeply held principles or guidelines that people use to guide their path and the decisions that they make. Everyone has personal values. These may include family, friends, education, respect, and honesty to name a few. *Stop and think: What are five values that are important to you?*

Architecture has its own set of values that guide professionals to create buildings or structures that meet the needs of the community. Just as each person's values are slightly different, so are the architectural design values of different times and places.

Over two thousand years ago, the Roman architect and engineer Vitruvius determined three main requirements of architecture: "Firmitas, Utilitas, Venustas" or firmness, utility, and beauty. These guidelines continue to inspire architects' designs today, as they also seek to add their own style and values. Let's take a closer look at each of these:

FIRMITAS

Firmness or strength –Buildings must be stable or firm. They must be able to hold their own weight, the weight of those who occupy them, and forces of nature. Firmness is a matter of the materials that are used as well as the form or style of the construction.

UTILITAS

Purpose or Utility – Buildings must be useful or have a function. At the most basic level, the function of a building is to protect. But all buildings – homes, schools, factories, etc – have a specific purpose for being built and the space and design must honor that purpose.

VENUSTAS

Beauty – Simply put, buildings must be beautiful. But how is beauty defined? Many different characteristics may be considered such as proportion, geometry, and ornament

NEWSPAPER LYNX

Look through your local paper to find three different buildings or structures that are featured through articles. Using context clues such as headlines, captions, text, or images, explain how each building does (or does not) uphold Vetruvius's values of firmness, utility, and beauty.

Building/Structure:	Firmitas	Utilitas	Venustas

FIRMITAS, UTILITAS, VENUSTAS IN THE 21ST CENTURY

Venustas: The Golden Ratio

Ratios, defined as the relationships between two numbers, are critically important in architecture. Architects, Planners, and Engineers must carefully calculate the ratios and proportions of the structures they are designing. As it turns out, the right ratio does not only ensure firmness (firmitas) and function (utilitas), but also beauty (venustas).

Before unveiling the golden ratio, it is important to learn about a sequence of numbers called the Fibonacci Sequence. This sequence of numbers is created by adding two successive numbers to get the next number. The first two numbers are 0 and 1 and 0 + 1 = 1 so the third number is 1. Adding 1 + 1 makes 2, the next number in the sequence, and so on. Add 21 to 34 to get the next number. Repeat the pattern to find the next five numbers:

0, 1, 1, 2, 3, 5, 8, 13, 21, 34, ___, ___, ___, ___, ___

1÷ 0 =
1 ÷ 1 =
2 ÷ 1 =
3 ÷ 2 =
5 ÷ 3 =
8 ÷ 5 =
13 ÷ 8 =
21 ÷ 13 =
34 ÷ 21 =
55 ÷ 34 =
89 ÷ 55 =
144 ÷ 89 =
233 ÷ 144 =
377 ÷ 233 =

Now that you know the Fibonacci Sequence, it is time to understand the golden ratio, symbolized by the Greek letter “phi,” and its relationship to architecture. To find the Golden Ratio, divide each number in the Fibonacci Sequence into the next number.

As you continue to divide larger numbers in the Fibonacci Sequence, you find that the ratio gets closer to 1.618034… The Fibonacci sequence works for any two numbers, as long as you find the next number by adding the previous two.

Try your own below:

___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___

The Golden Ratio in Architecture

The golden ratio or Fibonacci’s Sequence can be found in countless aspects of nature, from the spirals of shells to the seeds of a pinecone. Renaissance era artists referred to the golden ratio as the “Divine Ratio” and suggest that it is the most perfect ratio that can be used.

The Great Pyramid in Egypt is reported to have a base of 230.4 meters and a height of 146.5 meters. The ratio of the base to the height very nearly 1.618. A modern day example of the golden ratio exists in Toronto, home to the one of the world's tallest structures, The CN Tower. The total height of the tower is 553.33 meters. The visibly distinct observation deck is 342 meters in height. The ratio of the tower to the observation deck is phi, the golden ratio, or 1.618.

NEWSPAPER LYNX

Look through your local paper to find a building that is planned for construction. Using pencil and graph paper below, show a model of the exterior design of the building. Assume that each square on the grid represents one square foot.

Next, measure or count the width and the height of your building and record each. Divide the longer side by the shorter side and record that value.

Shorter Side: _____ Longer Side: _____ Longer Side ÷ Shorter Side _____

Is your ratio of the longer side to the shorter side close to the golden ratio of 1.618? If not, multiply the shorter side by the golden ratio to determine a new length for the longer side of the building. Sketch this new dimension in pencil. Examine both sketches. Which do you prefer and why? Do you think that the golden ratio is a standard for beauty in architecture? Explain.

Utilitas: Meeting the Need of the Community

Vetruvius championed the importance of "Utilitas" in architecture, or function and purpose. In short, architecture must meet people's needs. While architects often specify home or building designs to meet the needs of one client, urban planners are charged with the responsibility of appeasing the *entire* community. Urban planners plan the most effective way to use communal land and infrastructure (roads, utilities, schools, etc.) that will yield the greatest benefit to community members. Landscape architects work alongside urban planners, with the goal of encouraging sustainability and environmentally friendly activity.

Both urban planners and landscape architects are highly effective at solving problems. This can be challenging work. Sometimes the problems that arise do not have a quick solution. These professionals must perform research and administer surveys to their residents to discover individual needs as well as the needs of the community as a whole.

Here's a classic example: On the outskirts of a city near a residential area, an old building was demolished that freed a large plot of land. The City Council voted to build a recreation center in this location, but construction could not begin for a few years until there was money in the city's budget. To make good use of the space until then, the city's planners and landscape architects designed a dog park that would provide a needed service to the community. Local residents, many of whom live in nearby apartments, took advantage of the dog park and it proved to be an excellent use of the land. Three years later, the city secured the budget funding in order to begin construction on the recreation center and prepared to close the dog park. The local residents have expressed concern; they feel that the dog park was an asset to the community and do not know where to take their dogs if the park closes. City planners must make a choice: close the dog park and begin construction on the recreation center, leave the dog park in place and find new land on which to build the recreation center, or leave part of the dog park in place and construct the recreation center with less space and fewer amenities.

City planners are taking action. They are interviewing residents and administering surveys to understand the needs of the community. They are considering finding a new space for the dog park, and are working with the City to try to change current policies about off-leash dog areas so that more land can be used to meet the needs of the city. Residents are confident that the final decision will be the best for the community.

NEWSPAPER LYNX

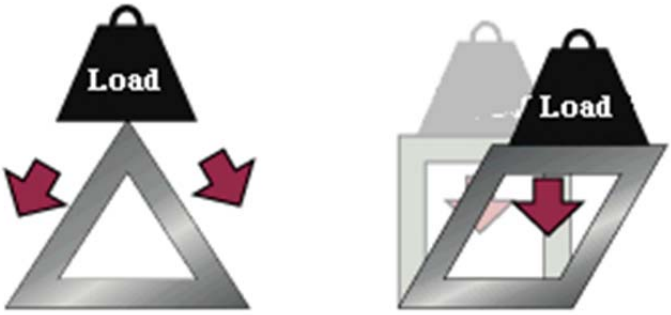
Look through your local paper to find a current planning issue in your town or city. What is the dilemma? What obstacles are hindering progress? What options or alternatives are being considered? What steps must the regional or urban planners take in order to make the best choice for the community? How would you take action?

LEARNING LYNX

Firmitas: More than Material

Firmitas - firmness or sturdiness – is the most straightforward of Vetruvius' architectural values. Shelter is a basic human need. Buildings must be designed to protect its inhabitants from elements of nature – heat, cold, and natural disasters. They must also be designed to handle wear-and-tear and the impact of years of use.

So what makes a building strong? The Tale of the Three Little Pigs would tell us that the materials we select determine how strong a building will be, but that is a small part of the story. The use of geometric shapes has allowed architects and engineers to design buildings and structures that can withstand the test of time. What makes a shape strong is the ability to resist force without deforming or changing shape. Consider a square, a rectangle, and a triangle of comparable sizes. Which shape do you think can support the heaviest load?



A square will eventually collapse under pressure because the angles can change without having the length of the sides change or bend.

A triangle cannot collapse unless the sides of the triangle change in length. That is because an angle is fixed by the length of each adjacent side.

Indeed, triangles are able to distribute weight equally without becoming deformed or failing. That is why triangles are so commonly used in the construction of bridges, skyscrapers, and geodesic domes. Squares are also commonly used in building construction, although they cannot withstand the same force. When an engineer designs a building, he or she knows how much weight a square structure can support and will add a diagonal beam – forming two triangles – to provide reinforcement.

NEWSPAPER LYNX

Find three buildings or structures in the newspaper that incorporate triangles into their design. Sketch these below, clearly showing where the triangles are. Use the Internet to support your search if needed. Finally, annotate each sketch with a sentence that describes how the triangle shape reinforces the structure.

MILO'S EXTRA CREDIT

Architecture on Ice

Flip through photos of an architecture exhibit in China that uses frigid yet surprisingly "firmitas" building material.
http://www.nytimes.com/2014/02/02/magazine/the-empire-state-building-in-ice.html?_r=1

Urban Planning

Read more about what it means to become an urban planner.
https://www.planning.org/ncpm/pdf/UrbanPlannerExcerpt.pdf

Digital History

Explore records of architecture and engineering design in the US dating back to 1933. Perform a search for your town or city. Do you recognize the buildings?
http://www.loc.gov/pictures/collection/hh/

ArchKIDecture

Hop into the Architecture Design Studio with Frank Lloyd Wright and simulate the architect's job as you work with your own clients.
http://www.architectstudio3d.org/AS3d/design_studiolite.html

COMMON CORE STATE STANDARDS

CCSS.MATH.CONTENT.6.RP.A.3.D
Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities.

CCSS.MATH.CONTENT.HSG.MG.A.1
Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).*

CCSS.ELA-Literacy.CCRA.R.7 Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.

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