



Quarrybrook

EXPERIENTIAL EDUCATION CENTER

Program Title: **Stone Structures (or What's the Quarry in Quarrybrook?)**

Audience: 5th grade students

Program Theme: In this introduction to civil engineering through inquiry learning, we will investigate the shapes and forces recognizable in the bridges and buildings all around us, and explore Quarrybrook's stonearch bridge, stone culverts, and surface quarry pits.

Program Goals: Students will understand the relationship between a structure's shape and its strength, and the forces at work within man-made structures. Students will know how Quarrybrook's stone structures were designed and constructed, using resources and tools available in 1848!

Next Generation/Common Core Connections:

Topics: 5-PS2 Motion and Stability: Forces and Interactions
5-ESS3 Earth and Human Activity

Dimensions: Cause and Effect, Systems and System Models

Program Outline:

Activity 1: SHAPES AND FORCES (40 min.) – Students will identify the familiar shapes seen within bridges and buildings, then test their stability and investigate how they distribute forces. Then we'll get a feel for those forces of pressure, stretch, and bending, with our teammates!



Throughout the program, teachers are welcome to make connections with any classroom investigations or discussions. Teachers and other chaperones will be helpful in keeping students involved in the demonstrations and encouraging students to share their observations.

Objectives: Students will recognize that bridges and buildings are designed with shapes that are familiar to us. Students will understand why triangles and arches are stable and strong. Students will know what abutments provide for an arch. Students will experience the forces of compression, tension, and bending, and the forces interacting within an arch and a dome.

Intended Outcomes: Students will test the stability of triangles, squares, and arches, and will be able to explain how their shapes distribute forces. Students will be able to recognize these shapes in photographs of ancient and modern bridges, and to explain how the architectural designs use interacting forces to provide stability and strength.

Activity 2: BUILD THE ARCH (35 min.) – Next we'll experiment with how an arch shape is built, and see what support is needed until the last block is in place. Then we'll investigate Quarrybrook's 1848 Stonearch Bridge!

Objective: Students will know the challenges to building an arch bridge and how to overcome them.

Intended Outcomes: Students will be able to recognize required design elements in an arch in all the photographs reviewed, and then will be able to notice and identify them in our Stonearch Bridge.

Activity 3: QUARRYING THE STONE BLOCKS (45 min.) – Next we'll investigate where our bridge's stone blocks came from, and how they were split out of the bedrock and moved here.

Objectives: Students will know where the rock blocks used to build Quarrybrook's stone structures came from, and will understand what a bedrock outcrop is, and its value as an accessible natural resource. Students will know what quarrying tools and techniques were used in 1848.

Intended Outcomes: Students will notice the drill marks remaining in the bedrock of our surface quarries. Students will comprehend the labor involved and will be able to explain the sequence of steps required to harvest the stone slabs.

Conclusion/Wrap-up: Group will review the themes investigated today, and discuss where else in their daily lives they will see these triangle and arch shapes working all around them.

Successful completion of this program will help support your students' proficiency in NGSS

Performance Expectations:

5-ESS3-1 Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.