



Lesson 2: Building with Wood and Stone

In this lesson, students explore the characteristics of materials and some early construction methods.

Support material: Information Sheet 20 “Compression, Tension and Span”, Worksheet C1. (Optional: slides/illustrations of Newgrange.)



Spotlight

Techniques and materials



Key Concepts

Spanning an opening

Review of work

Study the drawings of crannógs which students did for homework.

- What materials were used in their construction?
- Why were they designed in this fashion?
- How were they constructed?
- Do any truly ancient crannógs still exist today?

Discussion 1 — Wood and Stone



Key Concepts

Strength. Flexibility. Durability.

Materials: one large uncut stone, a branch from a tree or shrub

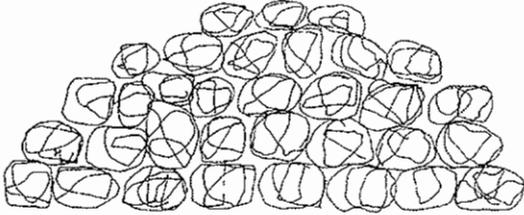
Show the stone and branch to the class. Examine the characteristics of each and discuss its suitability for building. Prepare a chart on the board with the headings “Wood” and “Stone”. List their characteristics under the following headings.

- How heavy is it?
- How flexible is it?
- How easy is it to cut and shape?
- How does it respond to temperature?
- How does it respond to water?
- Is it durable?
- How readily available is it?
- How versatile is it?
- Which is the stronger?

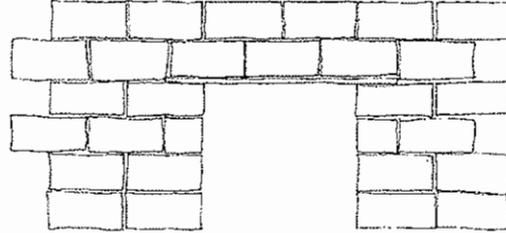


Activity 1 — Building a wall

Materials: sheets of newspaper squashed up into large irregular balls; cardboard boxes or books; 2 lengths of wood.



Newspaper wall



Box wall with opening

Select two pairs of students. Give one pair the “squashed” sheets of newspaper, which represent irregular stone shapes. Give the other pair the books or cardboard boxes, which represent regular blocks of stone. Using these materials, tell the students to find the best way of constructing a wall. Watch their efforts. Then discuss the results.

- Which is the more effective way of building a wall? Why?
- Which wall will be stronger and more durable? Why?
- Which method would be more labour intensive? Think about transporting, lifting, cutting, shaping.



Activity 2 — Making an opening

Now ask the students to make an opening for a “door” in each wall, using the lengths of wood to support the wall over the opening. Watch their efforts. Then discuss the results.

- What effect did creating an opening for a door have on the “blocks” above?
- Real stone would be much heavier than paper or cardboard. What effects would this have?

Discussion 2 — Spanning an opening

Distribute Information Sheet 20 “Compression, Tension and Span” which illustrates various structural concepts. Refer to these illustrations while discussing the following concepts with the class.

- The length of wood in the book/box wall represents a **lintel** — a supporting beam across the top of a door or window.
- The distance between the sides of the door or window is called the **span**.

Compression and Tension

Some materials are better at spanning distances than others. This is because of the way in which they react to **compression** and to **tension**.

- In compression, the material is squeezed or compressed by a weight.



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- In tension, a material is pulled or stretched by a weight.

In a lintel, the material is both squeezed and stretched. Both compression and tension are at work. This is because the lintel bends under the weight it carries. The bending may be so slight that it is invisible, but the lintel is squeezed (or in compression) at the top and stretched (or in tension) on the bottom.

Ask the class to answer these questions.

- Which material do you think is stronger in compression — wood or stone? Which is stronger in tension?

Answer: Stone is very strong in compression, but weak in tension. Wood is not as strong in compression, but it is strong in tension. It is quite strong in both tension and compression in relation to its weight.

- If stone is weak in tension, what effect will this have when it is used as a lintel?

Answer: One piece of stone cannot span very far, so you can only make narrow openings.

- So how would you span a wide opening in stone?

Answer: You could make an **arch**.

- And how would you build a whole room which is roofed in stone?

Answer: You could use **corbelling**. Ireland has an excellent example of this solution — Gallarus Oratory on the Dingle Peninsula, Co. Kerry.

Corbelling

Gallarus Oratory has a stone lintel over its narrow doorway, but its walls and roof are built in stone corbelling. In corbelling, layers of flat stones are placed one on top of another. Each layer juts farther inwards until the building is closed at the top with a stone called the capstone.

Another more sophisticated method of spanning a room in stone is to use a **barrel vault**.

- Ask students if they can name a building with which they are familiar which uses arches or barrel vaulting.

Historical perspective: Newgrange

Note: This is an optional discussion, depending on the time available. The school's art teacher should have slides showing Newgrange.

Another famous example of lintel and corbel construction is the burial mound at Newgrange, which was built during the Neolithic period (3000-2500 BC).

Newgrange is a corbelled passage grave in the Boyne Valley of Co. Meath. It was designed to house the cremated remains of the dead. Along with Knowth and Dowth, it is one of three such graves in the area. It has been estimated that 600-700 workers would have taken thirty years to build it.



Newgrange is made of 200,000 tons of stone, especially granite from the Mourne Mountains and quartz from the Wicklow Mountains. It is a heart-shaped mound with large and beautifully decorated stones at the base. The most important of these is the entrance stone. Surrounding the mound are seventeen large standing stones. It is thought that there were once about thirty-five of these stones.

The winter solstice (the shortest day of the year, around 21 December) is an important part of the design of Newgrange. On this one day, the light of the morning sun pours through the roof box and into the back chamber. The roof box has a stone lintel.

Homework

Distribute copies of Worksheet C1. Go over the worksheet with the class to make sure students understand the instructions.



Scrapbook

Remind students to check the worksheet for their **Scrapbook** assignments.

Vocabulary File

Students should update their files.

Cross-Curricular Connections

1. History and Art — Make a detailed study of the history of Newgrange. Include labelled drawings.
2. Art — Explore the motifs used to decorate the stones at Newgrange. Using plain bars of soap or another soft material, decorate some “stones” yourself with geometric motifs.
or
Design a clay tile or a lino print based on the Newgrange motifs.
or
Design a piece of jewellery based on the abstract geometrical patterns at Newgrange.
3. History/Geography: Class tour — Plan a visit to Newgrange. In advance, arrange for a group tour. Make a list of the information which you would like to collect before you go.
4. History/Archaeology — Choose one time period from ancient history and study the buildings from that period.
5. Geology/Geography — Find out about the different types of rock which are found in Ireland. Draw a map to illustrate Ireland’s geology. Find out what the different types of rock have been used for.
6. Construction Studies — How many kinds of stone lintels and arches can you find in your town? Make sketches, take photographs or make scale drawings.
7. Constructions Studies/Physics — Work out how a stone arch or barrel vault stays up. Illustrate your study with examples from buildings, bridges and other structures.



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8. Construction Studies/Photography — See how many methods of stone-coursing are used in your community. Photograph them.
9. Science/Construction Studies — Today, even glass can be used as a structural material. Discover as much as you can about the techniques used in building with glass. Illustrate your study with examples of 1980s and 1990s buildings from around the world.
10. Technology/History — Choose one material (wood, brick, concrete, steel, glass, copper) and study its use in buildings throughout history.
11. Technology/Construction Studies — Choose one building material (wood, brick, concrete or steel) and explore its construction possibilities. Illustrate your study with examples of buildings from the 19th and 20th centuries.
12. Science/Construction Studies — What accounts for the different behaviour of wood and stone when subjected to tension and compression? Investigate and report on your findings.