Newfoundland & Labrador

Let's Do Science

Grade 3 Materials and Structures

TEACHER'S GUIDE

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Materials and Structures

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Let's Do Science, Newfoundland and Labrador
Grade 3 Unit 2: Materials and Structures Teacher's Guide

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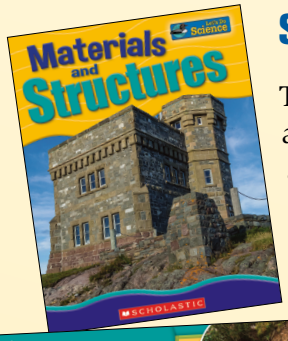
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Welcome to the *Materials and Structures* Unit

In this unit, students develop their understanding of materials and structures through a variety of explorations and investigations about various structures and their parts, what materials are best suited to particular structures, what makes structures strong and stable, and how to make their own strong structure. Multiple program components will engage students and support learning of the specific science concepts.

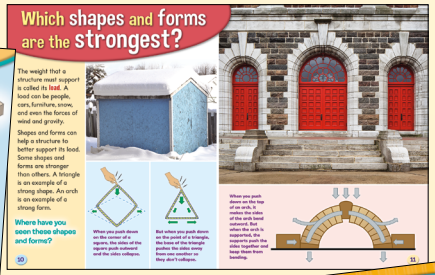


Student Magazine

The Student Magazine will support students' exploration of materials and structures. The bright, colourful photographs, detailed illustrations, and different text features will engage students and give them multiple opportunities to explore a variety of concepts. A digital version of the magazine is available on the Teacher's Website to be used with an Interactive Whiteboard.



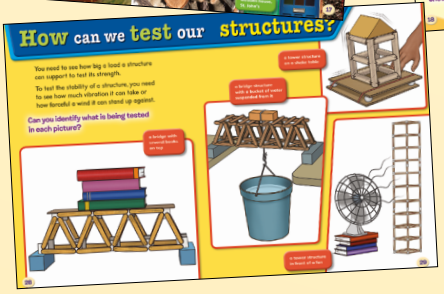


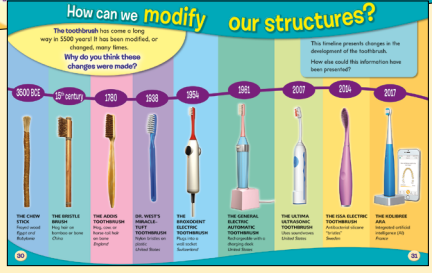


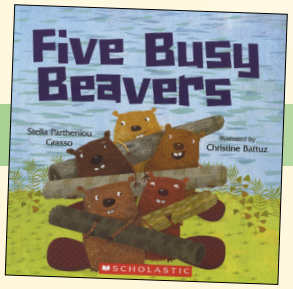












Science Read Alouds



Two Read Aloud texts allow you to introduce and engage students with science concepts. *Five Busy Beavers* by Stella Partheniou Grasso and Christine Battuz is a delightful counting book that uses rhyme to explore the steps in building a beaver dam and which can be used to introduce shapes and forms that are part of natural structures.

The Little Knight Who Battled a Dragon by Gilles Tibo and Geneviève Després invites exploration of the properties of some common materials and an evaluation of their suitability for use in structures such as a mechanical horse and appropriate tools for taming a fire-breathing dragon.



Anchor Video

The Anchor Video: *Materials and Structures*, found on the Teacher's Website, introduces students to essential questions about concepts including identifying natural and human-made structures, considering how materials are suitable for a structure's purpose, and how certain shapes and forms can make structures stronger and more stable. The video gives a number of examples to activate students' thinking and to promote questions.

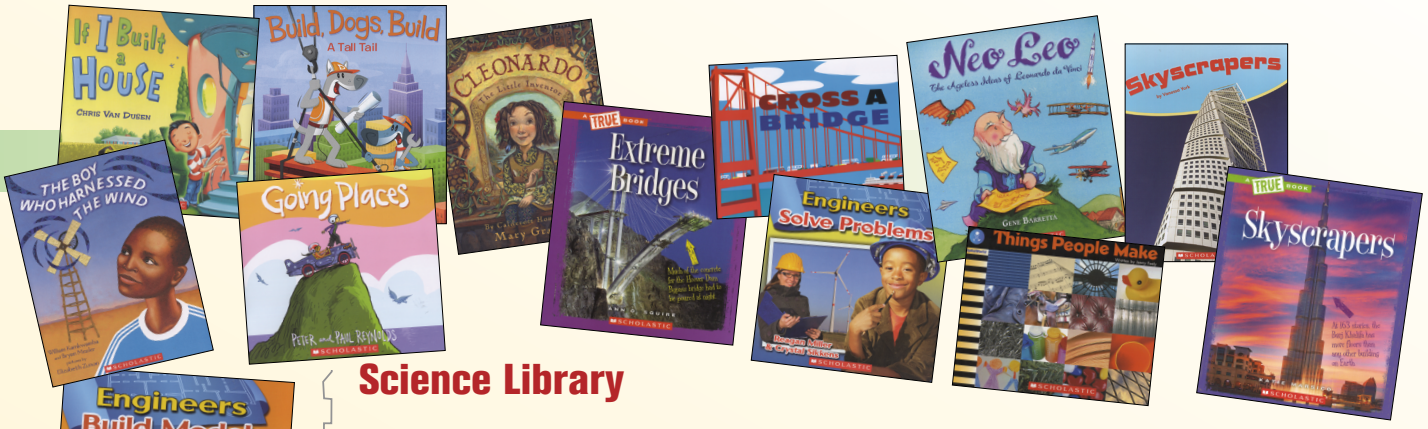


Poster

The *What Is the Design Process?* poster will support students as they learn to use the design process to create a solution for a problem.

Interactive Whiteboard Activities

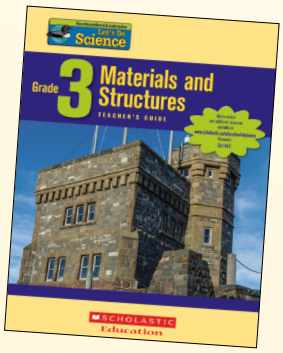
There are 9 interactive activities for the Interactive Whiteboard (IWB) found on the Teacher's Website. These activities provide students with a variety of hands-on learning experiences and the opportunity to apply learning in a supported environment. The IWB Activities are tied to the teaching plans to ensure that the learning is done in context.



Science Library

The Science Library provides a collection of colourful and engaging non-fiction and fiction texts at a variety of reading levels. These texts support students as they explore various science concepts and skills. See the *Science Library Guide* in the Teacher's Guide Binder or online for brief summaries, science connections, and suggested reading approaches (e.g., Independent Reading and Read Aloud).

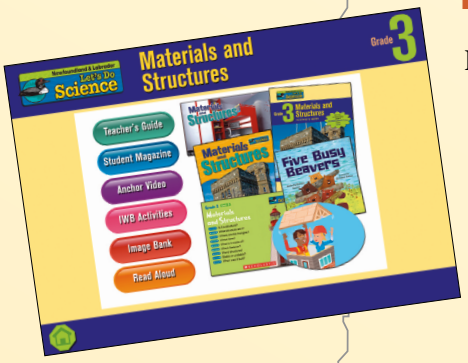
Teacher's Guide



This guide provides detailed suggestions for using all of the program components including the Student Magazine, Anchor Video, reproducible Blackline Masters (BLMs), and IWB Activities with your students. Visual cues such as book covers, thumbnail images, and icons highlight the use of each program component along with tools such as Science Folders and Journals, the Word Wall, and the I Wonder Wall. Strategies and tools you need to assess students' learning, such as rubrics and checklists, are also included.

Embedded within the teaching plans are connections to Guided and Shared texts from *Literacy Place for the Early Years*, Grade 3 that relate to the concepts in *Materials and Structures*.

Teacher's Website



In addition to the Student Magazine, Anchor Video, and IWB Activities mentioned above, the Teacher's Website provides a digital copy of the Teacher's Guide for this unit along with access to an image bank containing the variety of photographic images found in the Student Magazine and IWB Activities. These images may be used by teachers to create new IWB Activities or for students to incorporate into presentations. Find the Teacher's Website at

scholastic.ca/education/nlscience

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Planning Guide for *Materials and Structures*

Teaching Plans	Specific Curriculum Outcomes	Components	Materials	Literacy Place Connections
What Is a Structure? Students investigate various objects and decide whether they qualify as structures.	Skills [GCO 2] • 1.0	• Student Magazine pages 2–5 • Anchor Video: *Materials and Structures* • IWB Activity 1	• students' Science Journals • digital photos or flash cards showing natural structures (ant colony, wasps' nest, gopher hole, beaver dam, etc.) • students' Science Folders • digital cameras, tablets, or phones (optional)	
How Can We Describe Structures? Students learn terminology related to structures and use their knowledge to communicate with others.	Skills [GCO 2] • 2.0	• Student Magazine pages 6–7 • IWB Activity 2	• sheets of construction paper • markers and crayons • 12–15 index cards (3 per group)	
Which Shapes and Forms Are the Strongest? Students explore various shapes and forms to determine which ones are used in structures and which ones are best suited for structures.	Skills [GCO 2] • 21.0 • 22.0 STSE/K [GCO 1/3] • 19.0 • 20.0	• *Five Busy Beavers* (Read Aloud) • Student Magazine pages 8–11 • BLM *Results Table 1* • IWB Activity 3 • IWB Activity 4	• hardcover books (4 per pair of students) • rulers (1 per pair of students) • sheets of construction paper (3 per pair of students) • small plastic or paper cups (or yogurt containers) (2 per pair of students) • marbles (10 per pair of students) • students' Science Folders • pipe cleaners • computers or tablets with Internet access	

Teaching Plans	Specific Curriculum Outcomes	Components	Materials	Literacy Place Connections
What Makes Posts and Beams Strong? Students investigate how posts and beams help support a structure and how these elements can be made stronger and more stable.	Skills [GCO 2] • 21.0 • 22.0 STSE/K [GCO 1/3] • 20.0	• Student Magazine pages 12–15 • BLM *Results Table 2*	• 3 sheets of construction paper • markers and crayons • small containers of modelling clay (1 per pair of students) • cylindrical wooden craft sticks, all of equal diameter (4 per pair of students) • small, open milk containers (1 per pair of students) • marbles (20 per pair of students) • straws of equal diameter but of two different lengths (4 of each length per pair of students) • digital cameras (optional) • students' Science Journals • pre-cut pieces of string (1 per pair of students) • scissors (1 per pair of students) • small, open milk containers with two pre-punched holes on opposite sides, near the top • flat wooden craft sticks (1 per pair of students) • straws of two different lengths (1 of each length per pair of students) • students' Science Folders • computers or tablets with Internet access • bottles of white glue (1 per group) • several craft sticks (an equal number per group)	*Building a Skyscraper* (Guided Reading, Level N)
What Are Suitable Materials for Structures? Students explore the properties of various building materials and determine which materials are best suited for a particular structure.	Skills [GCO 2] • 6.0 • 24.0 STSE/K [GCO 1/3] • 23.0	• Student Magazine pages 16–19 • BLM *Placemat* • *The Little Knight Who Battled a Dragon* (Read Aloud) • IWB Activity 5 • BLM *Properties Chart*	• samples of various materials (blocks of wood, pieces of rubber, twigs, sheets of paper, balls of cotton, straws, pipe cleaners, wires, modelling clay, felt, aluminum foil, plastic wrap, sandpaper) • safety equipment for all students (goggles, aprons) • sheets of plastic or paper towels • various tools (e.g., spray bottles, hand-held fans, rubber mallets, scissors, sandpaper, tweezers, tongs, stir sticks, eyedroppers, hole-punch, stapler, glue gun) • computers or tablets with Internet access	

Continued on next page...

Planning Guide for *Materials and Structures* *(continued)*

Teaching Plans	Specific Curriculum Outcomes	Components	Materials	Literacy Place Connections
How Are Building Materials Joined Together? Students explore how building materials are joined together to form structures.	STSE/K [GCO 1/3] • 25.0 • 26.0	• Student Magazine pages 20–21 • IWB Activity 6	• sheets of construction paper • index cards (1 per student) • markers and crayons • large supply of Lego blocks • samples of various fasteners (e.g., glue, different kinds of tape, staples, twist ties, pipe cleaners, string, modelling clay, brass fasteners, Velcro, elastic bands, buttons, marshmallows) • samples of various materials (e.g., wooden sticks, straws, paper, stir sticks, fabric) • various tools (scissors, hole-punch, stapler, glue gun) • safety equipment for all students (goggles, aprons) • digital cameras (optional) • students' Science Journals • foam blocks • poster-making materials	
How Can We Evaluate Structures? Students evaluate the effectiveness and appropriateness of structures, and design a model home.	Skills [GCO 2] • 28.0 STSE/K [GCO 1/3] • 27.0	• Student Magazine pages 22–25 • IWB Activity 7	• any version of *The Three Little Pigs* • various drawing materials (grid paper, sketch paper, rulers) • various model-building materials (modelling clay, blocks of wood, Lego bricks, foam blocks) • computers or tablets with Internet access	*Tunnel Vision: Building an Underwater Tunnel* (Guided Reading, Level R)
Design Challenge: Build a Structure Students use the design process to build a strong and stable structure.	Skills [GCO 2] • 29.0 • 30.0 • 31.0 • 32.0	• Student Magazine pages 26–27 • IWB Activity 8 • *What Is the Design Process?* poster • BLM *Isometric Grid Paper*	• students' Science Journals • various building materials (e.g., cardboard boxes, paper towel rolls, newspaper, construction paper, card stock, chicken wire, fabric, plastic tubs) • various fasteners (e.g., different kinds of glue, different kinds of tape, staples, twist ties, pipe cleaners, string, modelling clay, brass fasteners, Velcro, elastic bands) • various tools (e.g., hand-held fans, scissors, hole-punches, staplers, glue guns, utility knives) • aprons and goggles for all students (optional)	

Teaching Plans	Specific Curriculum Outcomes	Components	Materials	Literacy Place Connections
How Can We Test Our Own Structures? Students test and evaluate their structures for strength and stability.	Skills [GCO 2] • 34.0 • 35.0 STSE/K [GCO 1/3] • 33.0	• Student Magazine pages 28–29 • BLM *TAG Feedback* (1 per group)	• students' Science Journals • binder covers or squares of plywood (2 per group) • large elastic bands (2 per group) • same-sized large marbles or small balls (4 per group) • poster-making materials	
How Can We Modify and Present Our Structures? Students use feedback from others to improve their structure and write a collaborative report.	Skills [GCO 2] • 17.0 STSE/K [GCO 1/3] • 36.0	• Student Magazine pages 30–31 • IWB Activity 9	• cellphone • images of telephones over time • groups' *TAG Feedback* forms from the previous class • students' Science Journals • report-writing materials • poster-making materials	

Preparing for the Unit

1. Curiosity Centre

The Curiosity Centre gives students an opportunity to investigate science ideas and tools through active participation, free exploration, and independent play. In this hands-on centre, students can touch and explore objects related to materials and structures.

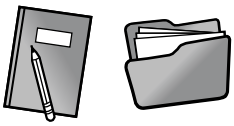
The Curiosity Centre could have

- a variety of natural and human-made materials for students to explore (except by taste), such as cotton balls, sandpaper, aluminum foil, plastic wrap, blocks of wood, Lego bricks, foam blocks, pieces of rubber, craft sticks, twigs, pieces of animal hide, feathers, stones, rocks, sheets of paper, newspapers, modelling clay, egg cartons, and pieces of fabric
- a variety of structures (both natural and human-made) for students to examine, such as a bird's nest, a wasps' nest, a wooden birdhouse or bat house, a dollhouse, Lego structures, craft-stick structures, plastic toys, an umbrella, a hard-boiled egg in its shell, a shoe, a bike helmet, a reusable shopping bag, a plastic cup, and various items from Indigenous culture such as actual or models of an inuksuk, an ulu (with a dull blade), a model komatik, mukluks, moccasins, or a snowshoe; models of traditional Innu or Mi'kmaq temporary structures could also be included

Check the centre frequently to ensure it is well stocked with items. Invite students to contribute to the centre by bringing in items or photographs related to materials and structures. Remind students to tidy up the centre when they are finished.

Note: You may choose to display new items every few days or introduce items one at a time throughout the unit. Allergy concerns must be considered before adding any item to the centre.

2. Science Journals and Folders



Check that students are recording appropriately in their Science Journals, ensuring that they date each entry and record ideas using sketches with labels, lists of words, or sentences. Continue to encourage them to add new questions or ideas to their Journals as often as they like.

Remind students that they should store completed BLMs, drawings, graphs, etc. that are related to the *Materials and Structures* unit in their Science Folders.

3. Word Wall



Add any relevant science terminology to the Word Wall throughout the unit. Urge students to use the terms as often as possible as they work through the unit.

4. I Wonder Wall

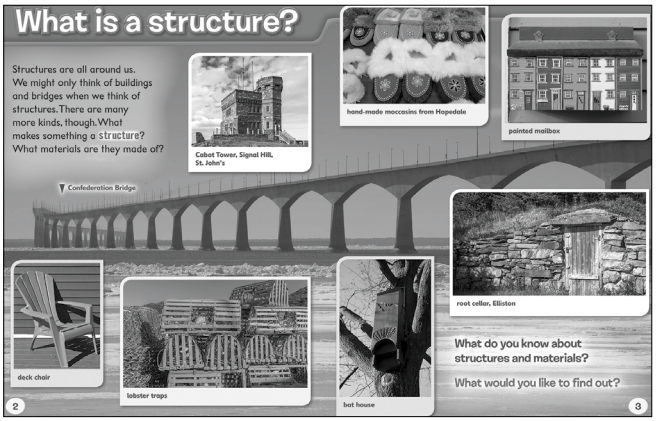


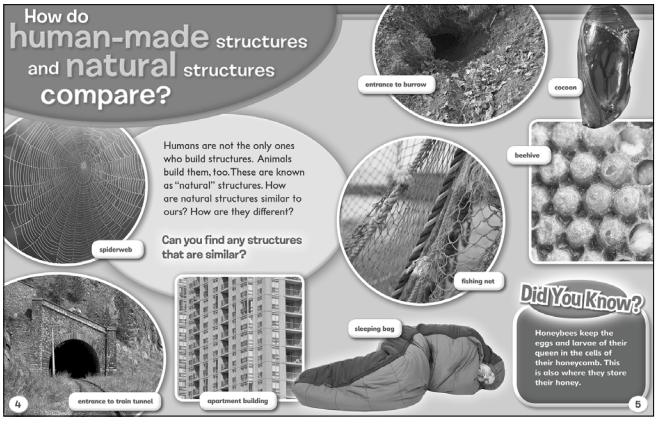
Build the I Wonder Wall throughout the unit by posting students' questions as they arise. Refer to the I Wonder Wall often and select questions that students may be ready to answer.

5. Reading Centre

Add texts (books, magazines, and photographs) relating to materials and structures to the Reading Centre. Or, you may choose to include these texts in the Curiosity Centre. The titles in the Science Library will help start off a collection of books. Also, refer to the lists of texts pertaining to *Materials and Structures* in the Additional Resources section of this guide (pages 74–75).

What Is a Structure?





Focus: Students investigate various objects and decide whether they qualify as structures.

Specific Curriculum Outcomes

Students will be expected to:

- 1.0 pose questions that lead to exploration and investigation [GCO 2]

Performance Indicators

Students who achieve these outcomes will be able to:

- ask questions to help them identify objects as structures
- list several examples of structures, both natural and human-made

NOTES:

Attitude Outcome Statements

Encourage students to:

- show interest in and curiosity about objects and events within their immediate environment [GCO 4]

Cross-Curricular Connections

English Language Arts

Students will be expected to:

- interact with sensitivity and respect, considering the situation, audience, and purpose [GCO 3]
- interpret, select, and combine information using a variety of strategies, resources, and technologies [GCO 5]
- create texts collaboratively and independently, using a variety of forms for a range of audiences and purposes [GCO 9]

Getting Organized

Components	Materials	Before You Begin	Vocabulary
• Student Magazine pages 2–5 • Anchor Video: *Materials and Structures* • IWB Activity 1	• students' Science Journals • digital photos or flash cards showing natural structures (ant colony, wasps' nest, gopher hole, beaver dam, etc.) • students' Science Folders • digital cameras, tablets, or phones (optional)	• Gather 4 or 5 images of natural structures (ant colony, wasps' nest, gopher hole, beaver dam, etc.), either in digital format or on flash cards. • Arrange for a field trip to visit an interesting local structure. • Invite an Elder or Indigenous Knowledge Keeper to visit the class.	• materials • structure

Safety

- Remind students to use appropriate senses (not taste) when exploring objects.

Science Background

- A structure is anything that is built, has more than one part, and serves a specific purpose.
- Structures are built using various materials, either raw or processed. They can be a variety of shapes and sizes.
- Both humans and animals build structures, including shelters and tools.

Possible Misconceptions

- Students may think that "a structure" means the same as "a building." Explain that structures are anything with more than one part that was built (by humans or animals) for a specific purpose.

- Students may think that some natural formations are actually structures, such as a log across a creek or a natural stone bridge. Bring them back to the definition of a structure as being something built for a specific purpose and having more than one part.

ACTIVATE



Curiosity Centre

Write the word "structure" on the Word Wall. Ask:

- **What do you think of when you hear this word?**

Students may respond by saying they think of a building, a bridge, a tower, the words "construct" and "construction," and so on.

Have students gather around the Curiosity Centre and encourage them to explore the items on it (materials such as cotton balls, sandpaper, aluminum foil, plastic wrap, blocks of wood, Lego bricks, foam blocks, pieces of rubber, craft sticks, twigs, felt, pieces of animal hide, feathers, stones, rocks, sheets of paper, pieces of fabric, and structures such as a bird's nest, a wasps' nest, a wooden birdhouse or bat house, a dollhouse, Lego structures, craft-stick structures, plastic toys, an umbrella, a hard-boiled egg in its shell, a shoe, a bike helmet, a reusable shopping bag, a plastic cup, and various items from Indigenous culture). Invite students to take turns choosing an item, and discuss as a class whether the item is a structure, and why or why not. Do not correct students at this time, or attempt to form a definition.

CONNECT



Introducing Structures

Introduce the Student Magazine and remind students that words in bold, red font can be found with a definition in the Glossary on page 32.

Have students open their Student Magazine to pages 2–3. Ask a volunteer to read the heading and the text aloud. Have students identify the structures on the spread, and ask:

- **What materials do you think were used to make the painted mailbox?** (wood, paint, metal hinges and nails)

Invite students to work in small groups to list what other materials they see in the remaining images.

Ask students what they would like to know about structures and materials. Encourage students to generate questions about the objects (use who, what, where, why, when, how or a question matrix). Record their questions on the I Wonder Wall. If necessary, model with questions such as:

- **Why do we have structures?**
- **Why did someone build this structure?**
- **How do people design structures?**

- **How are structures made? What materials are used?**
- **How do you think structures made by humans and animals are different?**



Anchor Video

Play the Anchor Video: *Materials and Structures,* which is located on the Teacher's Website. Set a focus for viewing by asking students to think about what makes something a structure. You may choose to pause the video to allow students to answer questions or to discuss any questions which students may have.



After playing the video, work with students to formulate a broad definition for "structure." Record the definition on chart paper and post it on the wall. Have students record the definition in their Science Journals. The definition should include some version of the following points:

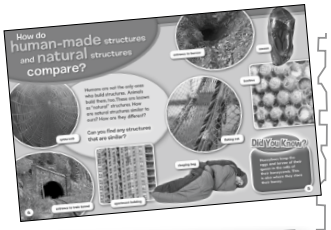
1. A structure is something that is built.
2. A structure is built for a particular purpose.
3. A structure has more than one part.
4. Structures can be built in a variety of shapes and sizes.

Animal or Human?

Ask students to identify any items at the Curiosity Centre that are "natural" (made by or which come from animals). Then show students a variety of images (either digitally or on flash cards), such as an ant colony, a wasps' nest, a gopher hole, and a beaver dam. Encourage students to discuss whether the natural objects on the table and the items in the images should be considered structures, and why or why not. Review the definition for "structure" that students recorded earlier and encourage them to use it to help them decide. Record any unanswered questions digitally or on the I Wonder Wall.



CONSOLIDATE

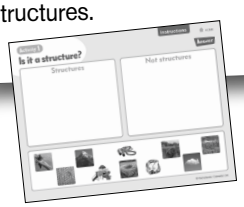


Is It a Structure?

Have students turn to pages 4–5 in their Student Magazine. Invite students to identify the natural and human-made objects on the spread, and discuss how they fit the definition of "structure." Then ask students to read the heading and text. Encourage students to suggest how natural structures are similar to and different from those made by humans. Record students' ideas on chart paper.

IWB Activity:

Have students use Activity 1: *Is it a structure?* (see the Teacher's Website) to identify items as structures or not structures.



Let's Compare

Invite students to choose partners. Ask each pair to choose two similar structures from pages 4–5 of the Student Magazine, one human-made and one natural (students may identify sleeping bag—cocoon; entrance to train tunnel—entrance to burrow; fishing net—web; apartment building—beehive). Have pairs fill in a Venn diagram to compare and contrast the structures. When pairs are finished, they can discuss their diagrams with another pair.

Classroom Search



Invite students to explore the classroom and make a list of three structures they see. Students should write a brief explanation of why they think each structure fits the definition they recorded in their Science Journals. Students may take digital photos of their finds using a smartphone, tablet, or digital camera.

Structures Field Trip

As a class, visit an interesting local structure (e.g., a bridge, church, house, or museum, including Indigenous museums or cultural centres). Before the visit, as a class, brainstorm a list of questions that the group would like to have answered. For example:

- **What is a structure made of?**
- **Why did the builders choose that material?**
- **Why is it shaped the way it is?**
- **What holds the structure up?**
- **How was it built?**
- **How are parts of the structure joined?**

Students might interview a guide or caretaker of the structure or talk to long-time local residents about their memories of the structure. Information might also be found at a public library or local historical society.

Classroom Visit

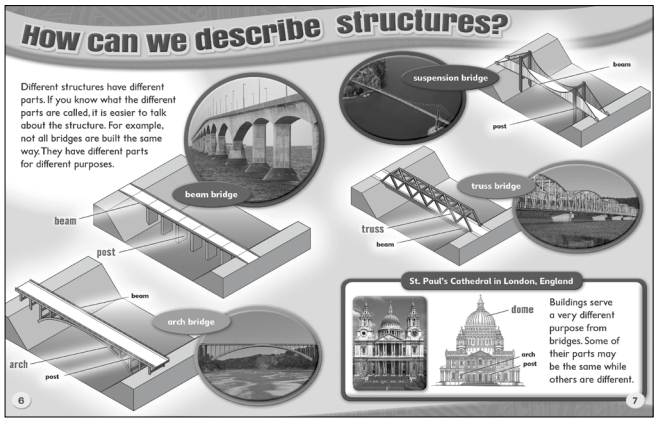
An Elder or Indigenous Knowledge Keeper could be invited to the classroom to describe or show different structures that are part of their culture (e.g., snowshoe, footwear, lodgings, etc.). The visitor could talk about those structures that are still being used, those that were important to traditional life, and how such structures helped them survive on the land.

EXPLORE MORE

Ants!

Provide students with access to tablets, computers, or a TV screen so they can watch an excerpt from the documentary *Ants: Nature's Secret Power* at https://www.youtube.com/watch?v = lFg21x2sj-M. The excerpt shows an abandoned giant anthill being excavated. Students can then either draw part of the ant "city" or write about how it is similar to and different from a human-made city.

How Can We Describe Structures?



Focus: Students learn terminology related to structures and use their knowledge to communicate with others.

Specific Curriculum Outcomes

Students will be expected to:

- 2.0 communicate using scientific terminology [GCO 2]

Performance Indicators

Students who achieve these outcomes will be able to:

- identify different parts of structures using the correct terminology

NOTES:

Attitude Outcome Statements

Encourage students to:

- recognize the role and contribution of science in their understanding of the world [GCO 4]

Cross-Curricular Connections

English Language Arts

Students will be expected to:

- create texts collaboratively and independently using a variety of forms for a range of audiences and purposes [GCO 9]

Getting Organized

Components	Materials	Before You Begin	Vocabulary
• Student Magazine pages 6–7 • IWB Activity 2	• sheets of construction paper • markers and crayons • 12–15 index cards (3 per group)	• Choose an image of a house that you can keep hidden from students. Consider a photo of a traditional longhouse, an Innu tent, Inuit snow house, or Mi'kmaq wigwam. Prepare a list of descriptive sentences about the house that do not include the vocabulary terms.	• ceiling • door • floor • roof • wall • window • arch • beam • dome • post • truss

Science Background

- Science concepts are more easily understood once students have the appropriate language with which to discuss them.
- It is important that students use the correct terminology when working in any area of science, and that they understand the errors that can occur as a result of using the wrong vocabulary.

ACTIVATE

Describing Structures

Tell students that you are going to describe a structure and that they are to picture what you describe. Tell them that you are not sure of the correct words to use, and that they should call out any terms they know. Then, referring to an image that you have chosen and kept hidden from students, describe the house in the image without using the specific words (door, window, roof, wall, floor, ceiling, and so on). For example, say:

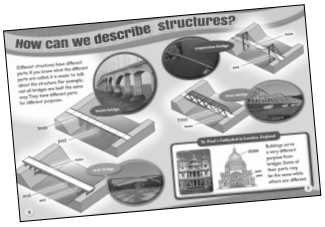
- **This structure has three ways of getting in and out.**
- **It has eight squares of glass that you look through.**

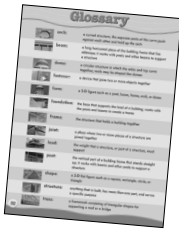
- **It has a lid on top in the shape of a triangle.**
- **The sides of each room are very high.**
- **The bottom of each room is covered with carpet.**
- **The top of each room is painted white.**



As you make each descriptive statement, allow students to call out terms to "help" you. For example, when you say, "It has three ways of getting in and out," students might say, "It has three doors." As students call out correct structural terms, add the words to the Word Wall. End the activity by asking students what they think your structure looks like, and what helped them to picture it (using the proper terms). Show them the image you have kept hidden and discuss how accurate their mind pictures were.

CONNECT







Structure Terminology

Have students turn to pages 6–7 of the Student Magazine. Ask them to examine the structures on the spread and to read the text to themselves. Then have students look at the labels around the structures (beam, post, arch, truss, dome). Have volunteers choose a label, say the word aloud, and explain what they think it means or what it is used for. Students can confirm meanings by checking the Glossary on page 32 of the magazine. Add these terms to the Word Wall.

CONSOLIDATE

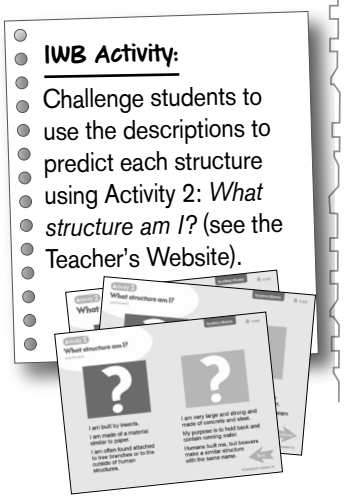
Structures Visual Dictionary



Students can create a class "Structures Visual Dictionary" to post on the classroom wall. Distribute sheets of construction paper to pairs of students, along with markers and crayons. Pairs can choose one or two of the words that you recorded on the Word Wall during the Activate and Connect activities or any other words that help describe structures, such as "materials," "measure," "design," "construct," "curve." For each word, students should write the term and a definition, and then draw a sketch to help explain the term (if appropriate). Dictionary entries can then be posted on the wall in alphabetical order.

IWB Activity:

Challenge students to use the descriptions to predict each structure using Activity 2: *What structure am I?* (see the Teacher's Website).

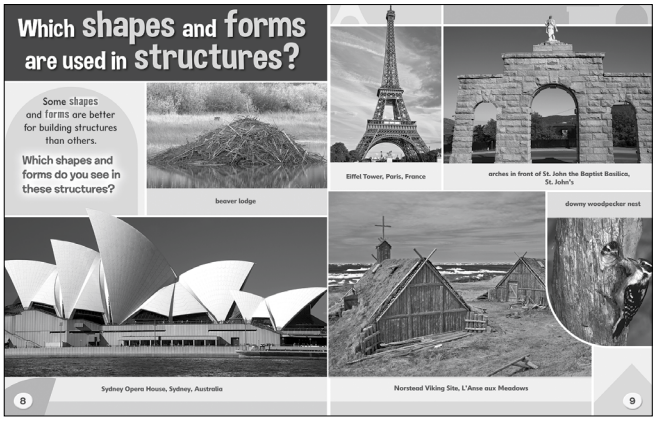


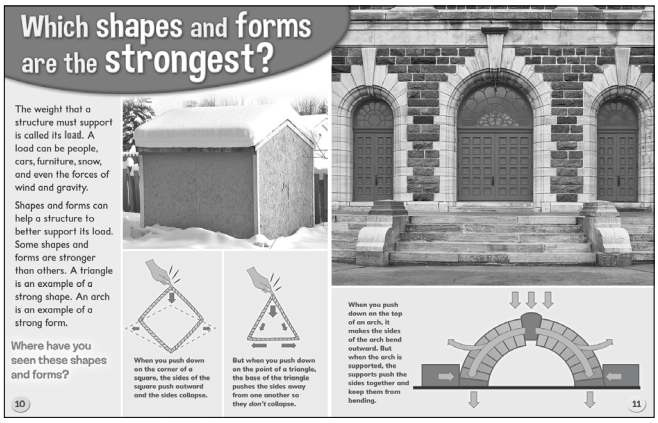
EXPLORE MORE

Structures "Jeopardy!"

Invite students to work individually, in pairs, or in small groups to create a "Jeopardy!" game based on structures terminology. Students record questions and answers on either side of index cards then challenge other class members to play the game. The winner is the person or persons with the most correct answers.

Which Shapes and Forms Are the Strongest?





Focus: Students explore various shapes and forms to determine which ones are commonly used in structures and which are best suited for structures.

Specific Curriculum Outcomes

Students will be expected to:

- 19.0 identify shapes and forms that are part of natural and human-built structures [GCO 1/3]
- 20.0 investigate and describe ways different shapes and forms help provide strength and stability [GCO 1/3]
- 21.0 follow a simple procedure [GCO 2]
- 22.0 identify and suggest explanations for patterns and discrepancies in objects and events [GCO 2]

Performance Indicators

Students who achieve these outcomes will be able to:

- identify several shapes and forms
- experiment with various shapes and forms to observe how strong they are
- record their observations in a results table
- explain why certain shapes and forms are stronger than others

NOTES:

Attitude Outcome Statements

Encourage students to:

- consider their observations and their own ideas when drawing a conclusion [GCO 4]

Cross-Curricular Connections

Math

It is expected that students will:

- describe 3-D objects according to the shape of the faces and the number of edges and vertices [3SS6]
- sort regular and irregular polygons, including triangles, according to the number of sides [3SS7]
- collect first-hand data and organize it using charts to answer questions [3SP1]

English Language Arts

Students will be expected to:

- speak and listen to explore, extend, clarify, and reflect on their thoughts, ideas, feelings, and experiences [GCO 1]
- communicate information and ideas effectively and clearly, and to respond personally and critically [GCO 2]

Getting Organized

Components	Materials	Before You Begin	Vocabulary
• *Five Busy Beavers* (Read Aloud) • Student Magazine pages 8–11 • BLM *Results Table 1* • IWB Activity 3 • IWB Activity 4	• hardcover books (4 per pair of students) • rulers (1 per pair of students) • sheets of construction paper (3 per pair of students) • small plastic or paper cups (or yogurt containers) (2 per pair of students) • marbles (10 per pair of students) • students' Science Folders • pipe cleaners • computers or tablets with Internet access	• Copy simple diagrams for Procedures 1 and 2 onto chart paper. When appropriate, post the diagrams on the wall for students to reference.	• circle • curved line • oval • rectangle • square • triangle • cube • cylinder • pyramid • sphere

Safety

- Caution students not to use too much force with one another as they follow Procedure 1: Triangles.

Science Background

- Shapes are generally defined as 2-D figures, such as circles, squares, rectangles, triangles, and curved lines. Forms are generally defined as 3-D figures, such as spheres, cubes, pyramids, cylinders, and cones. Forms also include arches and domes, in the context of structure building.
- Some shapes and forms are better suited to structures that need to support a load. Triangles, pyramids, and supported arches are among the strongest. They provide stability for the structure.
- The wider the foundation of a structure, the more stable it is.

Possible Misconceptions

- Students may think that a shape must look the same in every context. They may not recognize, for example, that a three-sided shape with the pointed end at the bottom is still a triangle. Expose students to a variety of types of triangles, rectangles, and curved lines. As each shape is identified, ask students how they can tell what the shape is.
- Students may believe that if an object is not moving, no forces are acting on it. Explain that gravity is a force that pulls things toward the earth, so it is always working on objects.
- Students may think that a square is just as rigid as a triangle, not able to be compressed and stretched like a circle is. Procedure 2 in this teaching plan is intended to clarify this concept for students.

ACTIVATE

Read Aloud: *Five Busy Beavers*



Summary

A charming story which uses rhyme and a familiar counting book format to explore how beaver dams are built.

Before Reading

Remind students that people aren't the only ones who build structures—many animals build them as well. Tell students that you are going to share a story about five busy beavers who are building a dam but whose many friends would like them to come and play instead.

Set a focus for listening by asking students to find out how a beaver dam is constructed, what materials are used to build it, and what shape it is.

During Reading

As you read the story to students, pause to clarify any vocabulary as necessary. You may wish to pay special attention to word choice and the variety of verbs/action words used to express types of movement. Prompts for discussion could include:

After reading pages 4–5:

- **What is the purpose of a beaver dam?** (to create a pond of deep, quiet water where beavers build their lodge, or home, to protect themselves from predators)
- **What do you thing "ferrying the logs" means?**
- **Why would they "slap on mud"?**

After reading pages 14–15:

- **What does it mean when it says, "one little beaver frolicked away"?**

After reading pages 16–17:

- **What is the mud and silt being used for?** (to fill holes and cracks; to reinforce and make the structure stronger)

After reading pages 20–21:

- **What does "shoring up the dam" mean?**
- **What "tricks" might a beaver use?**

After reading pages 24–25:

- **What does it mean to "make amends"?**
- **Do you think a beaver's lodge is made of the same materials as the dam? Why do you think this?**
- **Why are tree branches and mud good materials for building beaver dams and lodges?**

After reading pages 28–29:

- **Where is the "door" or entrance to a beaver lodge?**

After Reading

Ask if any students have ever seen a beaver lodge. Prompt by asking:

- **What shape does it have?** (a rough triangle shape with a wide base or bottom that narrows at the top—this is where beavers leave an air hole)
- **What other structures do we find in nature?** (e.g., birds' nests and wasps' nests)
- **What shapes or forms can we see in natural structures?**

Invite students to write and illustrate a procedure for building a beaver dam or lodge. Students may wish to do further research to add any interesting details such as the fact that beaver lodges have a foundation of piled stones

and mud on the riverbed, or that beavers line the inside of their lodges with dried plants and leaves.

Alternatively, students could research the procedure for constructing another natural structure such as a bird's nest. Have students identify any shapes and forms used in the structure.

Naming Shapes and Forms





Ask students to name as many shapes (2-D) and forms (3-D) as they can. On the Word Wall, draw and write the names of the shapes and forms as students call them out (e.g., circle, square, triangle, rectangle, oval, curved line, sphere, cube, pyramid, cylinder, arch).

Then have students turn to pages 8–9 in their Student Magazine, read the heading and text, and look at the images. Invite each student to choose a shape or a form (e.g., triangle, arch, curved line, circle) and to find examples of it in the structures shown on the spread. Discuss why the shapes and forms may have been chosen for the structures. Then ask what shapes they don't see. Students should identify squares and rectangles as shapes that have not been used very often in the structures shown.

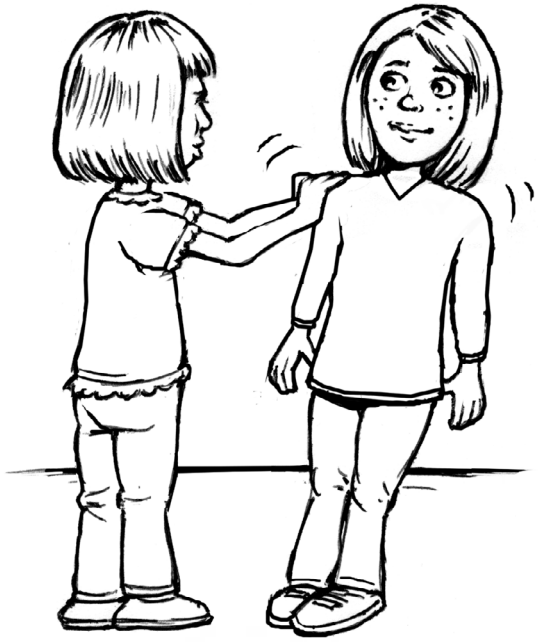
CONNECT

Following Procedures

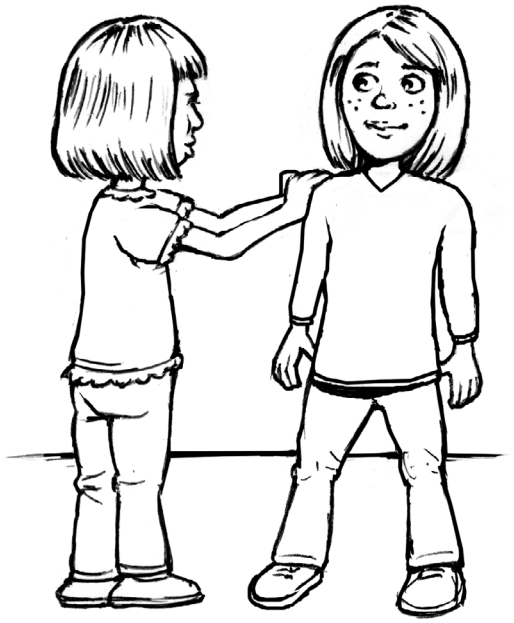
Ask students to consider which shapes and forms they might use to create a structure. What qualities would they want the shapes or forms to have? Tell students that they are going to test some shapes and forms by following two procedures.

Procedure 1: Triangles

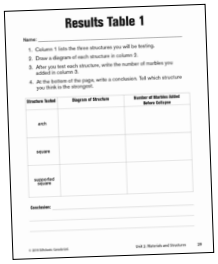
1. Working in pairs, one partner stands up tall with his/her feet together.
2. The other partner pushes gently on the first partner's shoulder to test his/her stability and strength.



3. Partners switch roles and repeat steps 1 and 2.
4. The first partner then stands with his/her feet spread apart.
5. The other partner pushes gently on the first partner's shoulder to test stability and strength in this new position.



6. Partners switch roles and repeat steps 1 and 2.
7. Partners evaluate which stance provided more stability and strength, and suggest reasons why.


Results Table 1

Name: _____

1. Column 1 lists the three structures you will be testing.
2. Draw a diagram of each structure in column 2.
3. After you test each structure, write the number of marbles you added in column 3.
4. At the bottom of the page, write a conclusion. Tell which structure you think is the strongest.

Structure Tested	Diagram of Structure	Number of Marbles Added Before Collapse
arch		
square		
supported square		

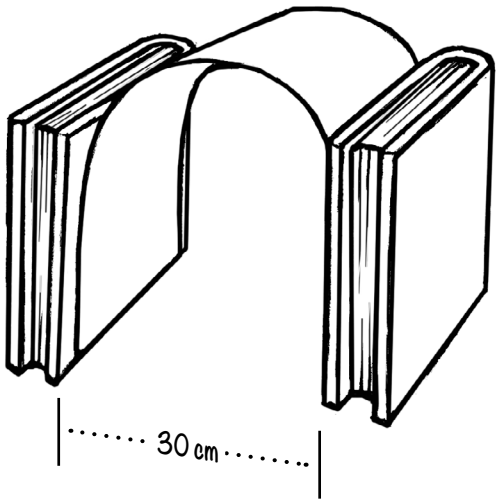
Conclusion: _____

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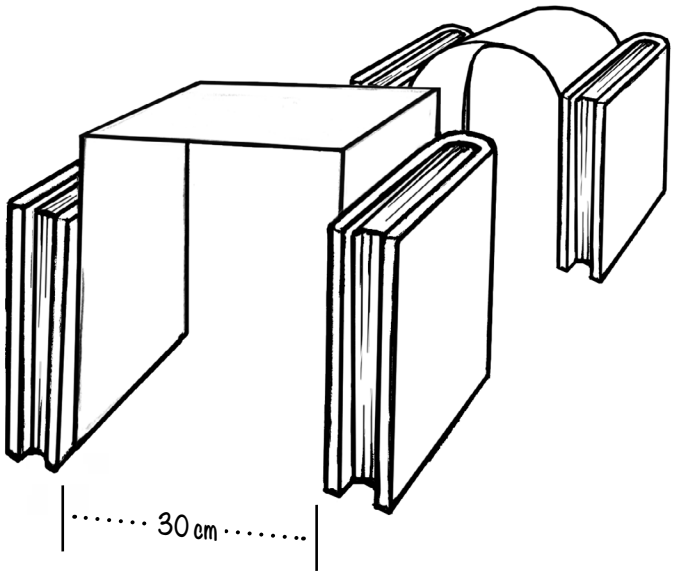
Procedure 2: Arches, Squares, and Triangles

Distribute BLM *Results Table 1* to each pair of students and have them use it to record their findings.

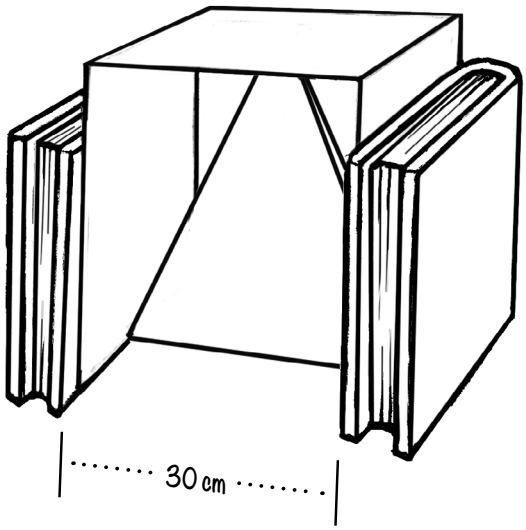
1. Partners stand two hardcover books up, about 30 cm apart. They then gently bend a sheet of construction paper and set it between the books to form an arch.



2. Beside the arch, partners stand up two more books about 30 cm apart. They then fold a second sheet of construction paper into thirds and set it between the books to form a square (with the floor or table top being the fourth side).



3. Partners gently place a small plastic or paper cup (or yogurt container) on top of each shape. One partner adds one marble to one cup, while the other partner adds one marble to the other cup. They continue slowly adding marbles to each cup until one of the shapes collapses (should be the square). Partners evaluate which shape was the strongest (the arch) and suggest reasons why.
4. Partners then fold a third piece of construction paper in half diagonally, twice, to form a triangle shape. They set up the arch shape and the square shape again, this time with the triangle shape under the square. They then repeat step 3.



Hold a whole-class discussion about the two procedures and students' findings. Discuss the conclusions that students wrote on their BLMs. Create a class table showing the number of marbles that were supported in each case. Encourage students to discuss discrepancies between pairs and why these might have occurred. Record any questions digitally or on the I Wonder Wall. Have students store their completed BLMs in their Science Folders.

Pipe Cleaner Shapes

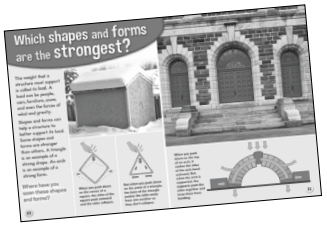
Provide students with pipe cleaners and invite them to use the pipe cleaners to make various shapes. Students can then test the strength and stability of the pipe cleaner shapes by pulling apart and pushing together opposite corners. Discuss students' observations and conclusions as a class. Then invite students to make the shapes stronger by reinforcing them in any way they wish. The shapes can then be placed on a continuum from strongest to weakest.

IWB Activity:

Students can use Activity 3: *Where are the triangles?* (see the Teacher's Website) to identify the triangle shapes within the structures and describe how the triangles make structures stronger.



CONSOLIDATE



Effect of Forces

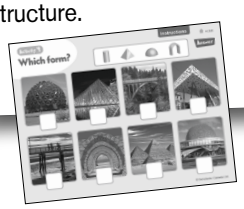
Have students turn to pages 10–11 of their Student Magazine. Ask a volunteer to read the heading then have students read the text. Discuss the technical drawings and explain how different forces act on the different shapes and forms. Remind students of their investigations with pipe cleaner shapes and discuss which shapes they found to be strong and stable. Ask:

- **What makes some shapes and forms stronger than others?**
- **Why is this important in structures?**

Ensure that students understand that a triangle is an example of a strong shape and an arch is an example of a strong form.

IWB Activity:

Students can use Activity 4: *Which form?* (see the Teacher's Website) to identify the forms which match each structure.



EXPLORE MORE

Shapes Lab

Students can work with the Shapes Lab at the Website http://www.pbs.org/wgbh/buildingbig/lab/shapes.html. Small groups can choose one of the three shapes, experiment with it in the Lab, and create a report on their observations. Groups can then do a Stay and Stray activity to share information with classmates.

Forces Lab

Students can work with the Forces Lab at the Website http://www.pbs.org/wgbh/buildingbig/lab/forces.html. Small groups can choose one of the five types of forces, experiment with it in the Lab, and create a poster showing their observations. Posters can be displayed in the classroom.

Results Table 1

Name: _____

1. Column 1 lists the three structures you will be testing.
2. Draw a diagram of each structure in column 2.
3. After you test each structure, write the number of marbles you added in column 3.
4. At the bottom of the page, write a conclusion. Tell which structure you think is the strongest.

Structure Tested	Diagram of Structure	Number of Marbles Added Before Collapse
arch		
square		
supported square		

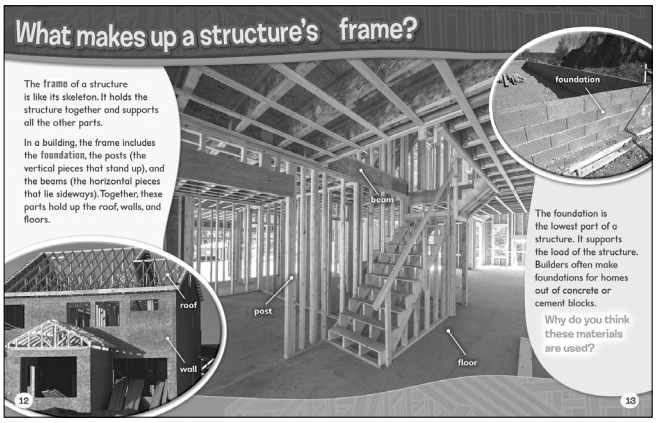
Conclusion: _____

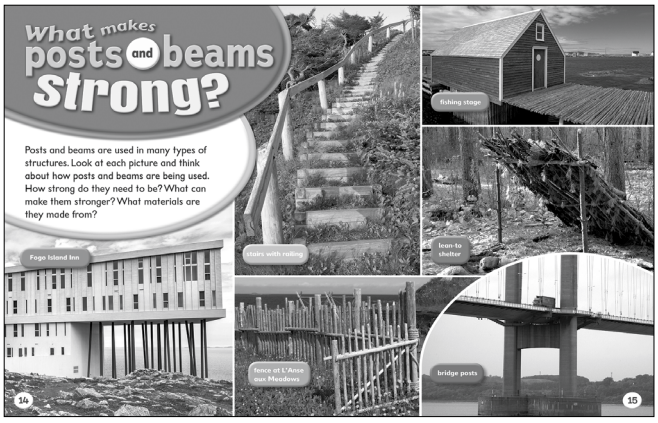
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_____

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What Makes Posts and Beams Strong?





Focus: Students investigate how posts and beams help support a structure and how these elements can be made stronger and more stable.

Specific Curriculum Outcomes

Students will be expected to:

- 20.0 investigate and describe ways different shapes and forms help provide strength and stability [GCO 1/3]
- 21.0 follow a simple procedure [GCO 2]
- 22.0 identify and suggest explanations for patterns and discrepancies in objects and events [GCO 2]

Performance Indicators

Students who achieve these outcomes will be able to:

- describe some ways that posts and beams can be used together
- investigate ways to make posts and beams stronger and more stable
- record their observations in a results table

NOTES:

Attitude Outcome Statements

Encourage students to:

- consider their observations and their own ideas when drawing a conclusion [GCO 4]

Cross-Curricular Connections

Math

It is expected that students will:

- collect first-hand data and organize using charts to answer questions [3SP1]

English Language Arts

Students will be expected to:

- communicate information and ideas effectively and clearly, and to respond personally and critically [GCO 2]

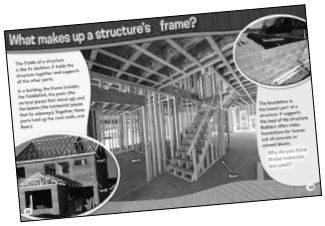
Getting Organized

Components	Materials	Before You Begin	Vocabulary
• Student Magazine pages 12–15 • BLM *Results Table 2* **Literacy Place:** • *Building a Skyscraper* (Guided Reading, Level N)	• 3 sheets of construction paper • markers and crayons • small containers of modelling clay (1 per pair of students) • cylindrical wooden craft sticks (such as dowelling), all of equal diameter (4 per pair of students) • small, open milk containers (1 per pair of students) • marbles (20 per pair of students) • straws of equal diameter but of two different lengths (4 of each length per pair of students) • digital cameras (optional) • students' Science Journals • pre-cut pieces of string (1 per pair of students) • scissors (1 per pair of students) • small, open milk containers with two pre-punched holes on opposite sides, near the top • flat wooden craft (1 per pair of students) • straws of two different lengths (1 of each length per pair of students) • students' Science Folders • computers or tablets with Internet access • bottles of white glue (1 per group) • several craft sticks (an equal number per group)	• Use a single-hole punch to create holes in several small, open milk containers (1 per pair of students). Punch both holes near the top, on opposite sides of the container. • Cut several pieces of string (1 per pair of students), at varying lengths.	• beam • foundation • frame • post

Science Background

- A post is a main vertical support in a structure, while a beam is a main horizontal support.
- The strength and stability of posts and beams depends partly on their length (the shorter a post or beam, the stronger and more stable it is) and on the material used (rigid material is stronger and more stable than a flexible material). The width or thickness of posts and beams also determines their degree of strength and stability. The wider the surface area at the top of a post, the more weight it can support. The thicker the beam, the better it can resist bending.
- Posts that will be subjected to horizontal forces should be stabilized by a wide base and supports that join the post to the base. This will prevent the post from leaning.
- The heavier the load to be carried by a beam, the more posts there should be to support the beam. This will prevent the beam from bending.

ACTIVATE





Definitions

Have students look at pages 12–13 in their Student Magazine and read the text. Then have the class create definitions for "frame" and "foundation." (A "frame" holds a structure together. A "foundation" is the lowest part of a structure that can support weight.) Discuss with students why concrete and cement blocks are appropriate materials for building foundations for homes. As a class, create two new entries for the "Structures Visual Dictionary" and then review the entries for "beam" and "post." Add the terms "frame" and "foundation" to the Word Wall.

CONNECT

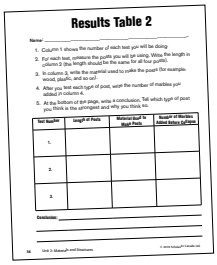


Posts and Beams

Have students examine pages 14–15 in their Student Magazine and discuss the various set-ups of posts and beams shown. Ask:

- **How are the set-ups similar? How are they different?**
- **What materials are they made from?**

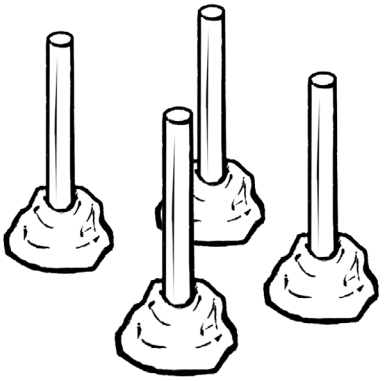
Ask students to consider what size the posts and beams should be in a structure. Tell students that they are going to test the size and strength of some posts and beams by following two procedures.



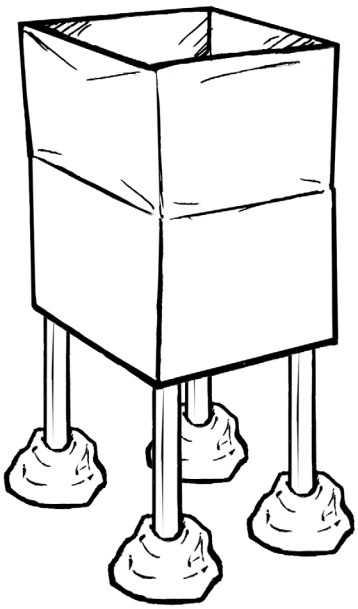
Procedure 1: Posts

Distribute BLM *Results Table 2* to each pair of students and have them use it to record their findings.

1. Partners lay down four lumps of modelling clay in a square formation. They then stand a short cylindrical craft stick (such as dowelling) in each lump to create a vertical post. The four sticks should all be the same thickness and length.



2. Students gently set a small, open milk container on top of the four posts.



3. Partners take turns adding one marble at a time to the milk container until the container and/or posts collapse. Partners should note how many marbles were successfully supported.

4. Students set up the structure again, this time using straws of approximately the same length and diameter of the craft sticks and the same lumps of clay as bases. Partners then repeat step 3, again noting the number of marbles that were successfully supported. At this point, partners should suggest explanations for the differing results.

5. The structure is set up a third time, using long straws. Partners again repeat step 3 and note the number of marbles supported.

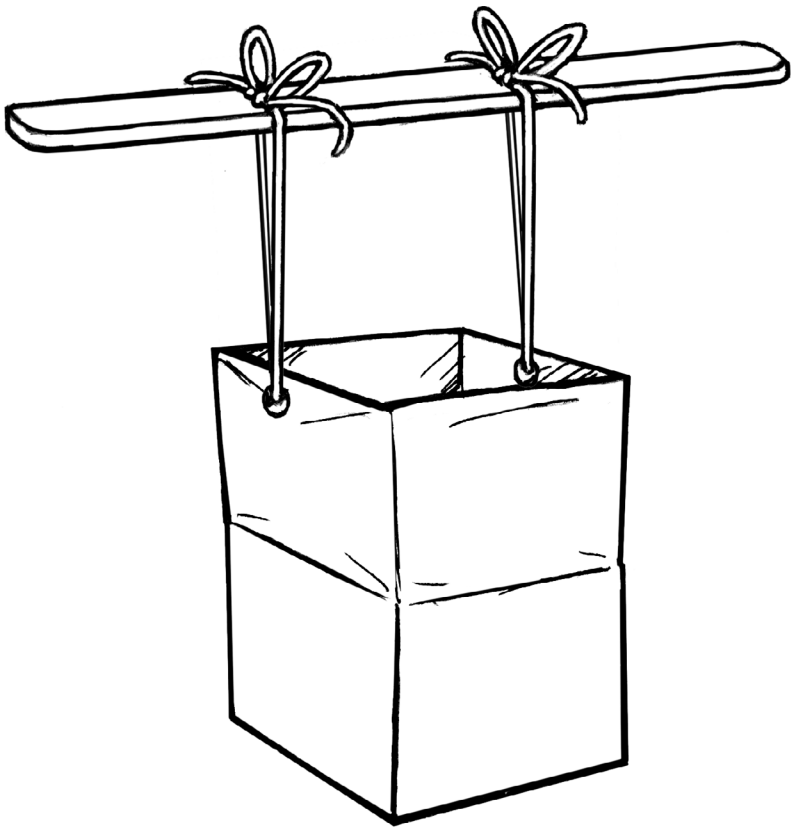
6. Partners evaluate which posts provided more stability and strength, and suggest reasons why.

Create a class table showing the number of marbles that were supported in each case and discuss any discrepancies as a whole group.

Procedure 2: Beams

Ask each pair of students to choose a method of recording their findings, either digitally or in their Science Journals.

1. Provide each pair with a piece of string. Partners fold their piece of string in half and cut it in the middle, creating two shorter strings of equal length. They thread each string through a pre-punched hole in the top of a small, open milk container.
2. They then tie the strings around a flat wooden craft stick. One partner holds the stick horizontally so that the container hangs underneath.



3. Partners take turns adding one marble at a time to the milk container until the container is full or the "beam" breaks. Partners should note how many marbles were successfully supported.
4. Students set up the structure again, this time using a straw of approximately the same length as the craft stick. Partners then repeat step 3, again noting the number of marbles that were successfully supported. They should also suggest explanations for the differing results.
5. The structure is set up a third time, using a longer straw. Partners again repeat step 3 and note the number of marbles supported.
6. Partners evaluate which beam provided the most stability and strength, and suggest reasons why.

Create a class table showing the number of marbles that were supported in each case and discuss any discrepancies as a whole group.

CONSOLIDATE

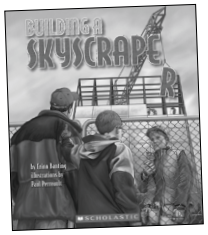
Group Discussion

Bring students together and hold a whole-class discussion about the two procedures. Discuss the conclusions that students wrote on their BLMs. Discussion should elicit the following concepts, which should be recorded on chart paper and copied into students' Science Journals:

The strength and stability of posts and beams depends on

- their length—the shorter a post or beam, the stronger and more stable it is
- the material used—a rigid thicker material is stronger and more stable than a flexible material

Encourage students to discuss discrepancies between partners' findings and why these might have occurred. Record any questions on the I Wonder Wall. Have students store their completed BLMs in their Science Folders.



Literacy Place Connection:
Building a Skyscraper (Guided Reading, Level N) incorporates illustrations, photos, and text to explain the process of building a new office tower. Share the text and discuss with students the importance of a strong foundation and frame in supporting a building such as a skyscraper.

EXPLORE MORE

Comparing Structures

Students could look at models or photos of Innu tents to identify the posts, beams, and other means of support. Students could also compare post and beam construction of western houses with traditional Indigenous shelters such as the Innu tent, Inuit snow house, and Mi'kmaq wigwam. They could discuss how the structures are similar to and different from the western styles. Students can suggest why such structures came to be built in the different environments.

Loads Lab

Students can try the Loads Lab at the Website
http://www.pbs.org/wgbh/buildingbig/lab/loads.html.
Groups or partners can then build small structures using white glue and a set number of craft sticks. Challenge students to build structures that can support the weight of a book.

Results Table 2

Name: _____

1. Column 1 shows the number of each test you will be doing.
2. For each test, measure the posts you will be using. Write the length in column 2 (the length should be the same for all four posts).
3. In column 3, write the material used to make the posts (for example, wood, plastic, and so on).
4. After you test each type of post, write the number of marbles you added in column 4.
5. At the bottom of the page, write a conclusion. Tell which type of post you think is the strongest and why you think so.

Test Number	Length of Posts	Material Used to Make Posts	Number of Marbles Added Before Collapse
1.			
2.			
3.			

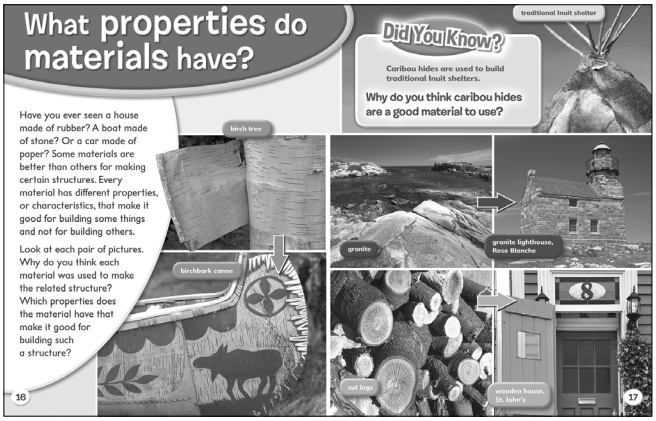
Conclusion: _____

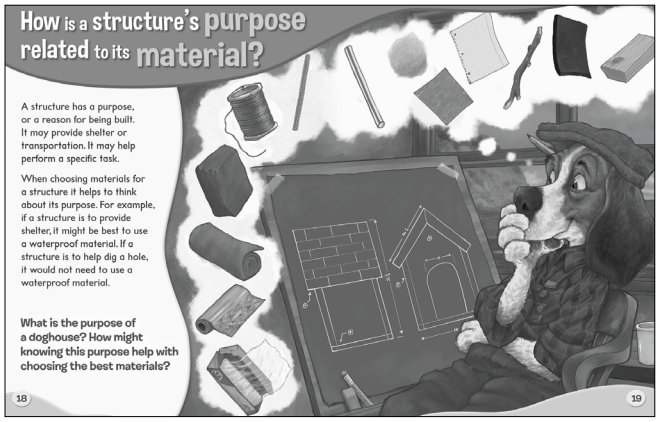
_____

_____

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What Are Suitable Materials for Structures?





Focus: Students explore the properties of various building materials and determine which materials are best suited for a particular structure.

Specific Curriculum Outcomes

Students will be expected to:

- 23.0 describe the properties of some common materials and evaluate their suitability for use in building structures [GCO 1/3]
- 6.0 use appropriate tools [GCO 2]
- 24.0 identify the most useful method of sorting [GCO 2]

Performance Indicators

Students who achieve these outcomes will be able to:

- describe some of the properties of various materials
- explain why certain structures are made of certain materials
- sort materials according to their suitability for building a specific structure

NOTES:

Attitude Outcome Statements

Encourage students to:

- willingly observe, question, and explore [GCO 4]

Cross-Curricular Connections

English Language Arts

Students will be expected to:

- speak and listen to explore, extend, clarify, and reflect on their thoughts, ideas, feelings, and experiences [GCO 1]
- select, read, and view with understanding a range of literature, information, media, and visual text [GCO 4]
- respond personally to a range of texts [GCO 6]

Getting Organized

Components	Materials	Before You Begin	Vocabulary
• Student Magazine pages 16–19 • BLM *Placemat* • *The Little Knight Who Battled a Dragon* (Read Aloud) • IWB Activity 5 • BLM *Properties Chart*	• samples of various materials (blocks of wood, pieces of rubber, twigs, sheets of paper, balls of cotton, straws, pipe cleaners, wires, modelling clay, felt, aluminum foil, plastic wrap, sandpaper) • safety equipment for all students (goggles, aprons) • sheets of plastic or paper towels • various tools (e.g., spray bottles, hand-held fans, rubber mallets, scissors, sandpaper, tweezers, tongs, stir sticks, eyedroppers, hole-punch, stapler, glue gun) • computers or tablets with Internet access	• Prepare a collection of material samples for each group, with one sample of each material. • Prepare a collection of tools for each group, with one of each tool.	• properties • purpose

Safety

- Remind students to use appropriate senses (not taste) when they are examining objects at the Curiosity Centre.
- You may choose to have students wear safety goggles and aprons while they are working with the tools in this lesson.
- Review appropriate safety rules with students before giving them access to any tools.

Science Background

- The use of a material in building a structure is determined by the properties of the material and the purpose of the structure.

- Some properties to consider when assessing the suitability of a material for building a specific structure include its strength, flexibility, texture, water resistance, and durability.
- Natural materials may be processed in a way that enhances or changes their properties.

Possible Misconceptions

- Students may think that "material" is the same as "fabric" or "cloth." Emphasize that anything an object is made of can be considered a "material," such as wood, plastic, metal, animal hide, or fabric. Explain that materials can be natural or made by humans. Point out that some cultures use materials that students wouldn't normally consider to be a building material such as snow for Inuit snow houses or igloos, or brush for temporary or emergency structures such as a lean to or a bush shelter.
- Students may also have difficulty explaining why certain materials are well suited for certain purposes. This is partly because they are not distinguishing between the object and what material the object is made of. They may, for example, say that a raincoat is well suited for staying dry because that is the purpose of a raincoat. Explain that the material the raincoat is made of is what makes it well suited for staying dry, because the material is waterproof.

ACTIVATE

Curiosity Centre

Have students gather around the Curiosity Centre and examine the structures on it. Invite them to name any materials they recognize (e.g., metal, wood, plastic, rubber, twigs, eggshell, animal hide, birch bark), and record the materials on chart paper.

Then choose a structure and ask students what would happen if it were made from a different material. For example, what would an umbrella made of wood be like? A birdhouse made of metal? A shoe made of eggshells?

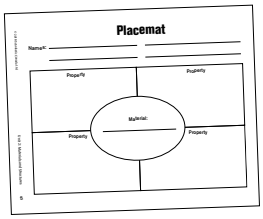


Materials and Structures

Have students read pages 16–17 of the Student Magazine. Discuss the structures made from each of the natural materials shown. Encourage students to explain why each material was used, discussing one material and structure at a time. As students discuss the materials, record any properties they mention (e.g., warm, strong, easy to find, smooth). Review with students that these are all "properties," and that every building material has a certain set of properties. Add the word "properties" to the Word Wall.



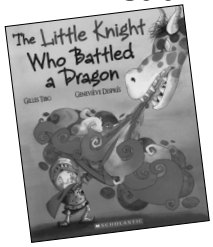
Placemat



Divide the class into groups of four and distribute a copy of BLM *Placemat* to each group. Have each group select a material from the Curiosity Centre. Students write the material in the middle of their placemat. Then have each student think of a property of that material and write his/her ideas in one of the placemat blocks. BLMs can be posted on the wall.

CONNECT

Read Aloud: *The Little Knight Who Battled a Dragon*



Summary

A little knight must face a fire-breathing dragon with only his sword, his shield, and an old iron horse.

Before Reading

Remind students that all materials have certain properties that make them suitable, or sometimes unsuitable, for use in certain structures. Tell students that you are going to share a story about a knight who must face a fire-breathing dragon in order to keep his village safe.

Set a focus for listening by asking students to notice what structures the little knight uses when he faces the dragon and what materials these structures are made of. Explain that students will be asked to describe the suitability of the materials used.

During Reading

Read the story aloud focusing on the main text of the story for the initial reading. Pause to clarify vocabulary or concepts as necessary. Alternate between asking students to respond in a whole group or with a partner. Prompts for discussion could include:

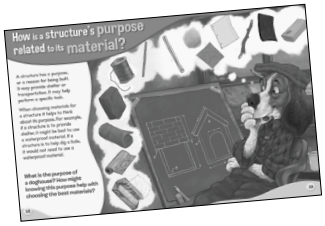
- **Why does the little knight say that he can't battle a fire with a wooden sword, a wooden shield, and a wooden horse?**
- **What are the properties of wood? Why would wood be used to make a sword? A shield? A horse?**
- **Why isn't wood a suitable materials for battling a fire? Which properties make it unsuitable?**
- **What structures do the villagers bring to the little knight? What are these items made of?** (a metal shield, steel lasso, flame-proof breastplate, and an iron horse)
- **What properties do metals such as iron and steel have?**
- **What makes these materials suitable for battling a fire?**
- **Every time the old horse "shook with fear," pieces of metal fell onto the ground. What tools did the little knight use to repair the iron horse?** (pliers and screws)
- **Why were these tools appropriate?**
- **Why was the dragon upset and breathing fire?**
- **Did you like the way the little knight handled the situation with the dragon?**
- **What might you have done to help the dragon get out of the trap?**

After Reading

When you have finished the story, remind the students that the little knight's iron horse fell apart and he had to put all the pieces back together but he didn't really know how to rebuild it. When he put it back together, the iron horse looked different than it did originally. Ask:

- **Was his new horse structure effective and appropriate?** (Yes. The small text says, "it looks different but is stronger than ever.")
- **Do you think structures built for the same purpose (i.e., to transport a rider) can be constructed differently?**

Invite students to sketch their own iron horse and have them label the various materials used to build it.



Suitable Materials

Ask students to read the text on pages 18–19 of the Student Magazine. Then have them brainstorm answers to the two questions:

- **What is the purpose of a doghouse?**
- **How might knowing this purpose help with choosing the best materials?**

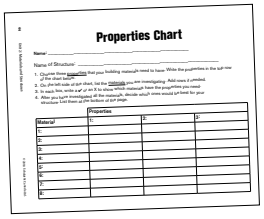
Students can then take turns choosing one of the materials pictured on the spread (wood, rubber, twig, paper, sandpaper, cotton ball, straw, pipe cleaner, wire, modelling clay, felt, aluminum foil, plastic wrap) and evaluating how suitable it would be for building a doghouse. For ideas, encourage students to refer to the posted *Placemat* BLMs listing properties of materials.

IWB Activity:

Using Activity 5: *What is it made of?* (see the Teacher's Website) students identify the materials used for each structure and explain whether or not the material was an appropriate choice.



CONSOLIDATE



Properties of Building Materials

Divide the class into small groups and distribute BLM *Properties Chart* to each group. Assign a structure to each group (e.g., chair, slide, tree fort, bunk bed) and have members work together to identify what properties would be required in the materials used to build that structure. Groups can record their structure and properties on the BLM.



Provide students with several samples of the materials on pages 18–19, along with various tools (e.g., spray bottles, hand-held fans, rubber mallets, scissors, tweezers, tongs, stir sticks, eyedroppers, hole-punch, stapler, glue gun). Be sure to review safety rules with students before they access any tools. You may wish to have students wear aprons and safety goggles during this activity, and cover their work area with plastic or paper towels.

Groups can investigate the suitability of various materials by testing them for the properties they require for their structure. For example, if they need materials that are waterproof, they can spray water on various materials.

If they need materials that are windproof, they can place various samples between a hand-held fan and another object. Groups can fill in BLM *Properties Chart* to indicate whether each material has the properties they require. Groups should then sort their materials to decide which ones they would use for their structure. They can record their decisions at the bottom of the BLM.

Note: This activity may require an adult volunteer to provide supervision and assistance as needed.

EXPLORE MORE

Materials Lab

Students can work with the Materials Lab at the Website http://www.pbs.org/wgbh/buildingbig/lab/materials.html.

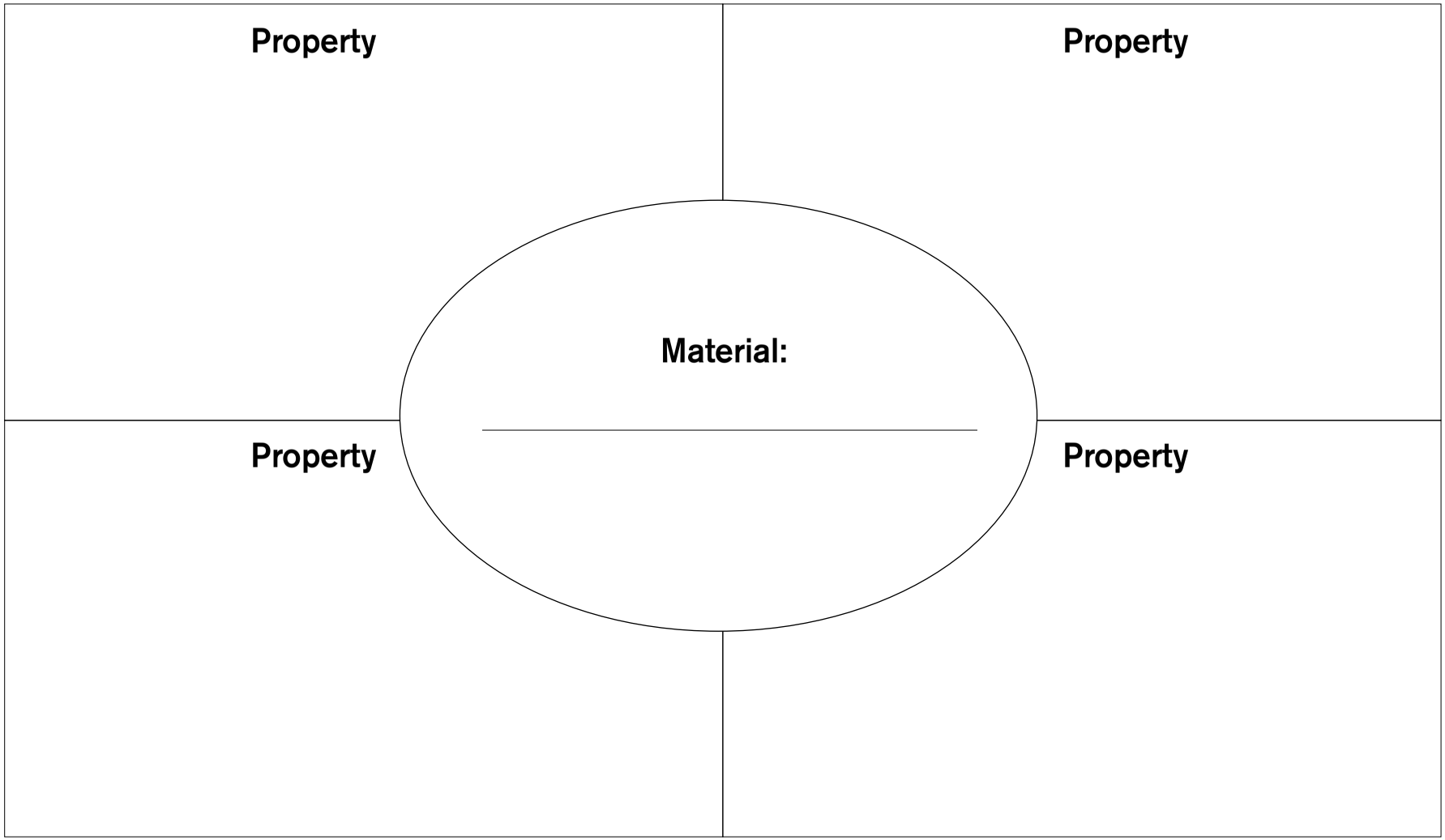
Shelters

Students can research and compare the traditional shelters of the Vikings at L'Anse aux Meadows with those of the Beothuk, the Mi'kmaq, Inuit, and the Innu, and even to early European settlers' log cabins and salt box houses. Their research should focus on why these shelters were made with certain materials and not others. Students can prepare posters to share their research with others.

Placemat

Names: _____ _____

_____ _____



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Properties Chart

Name: _____

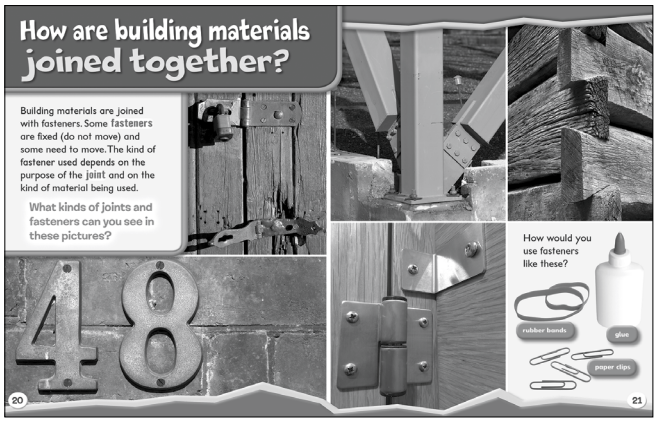
Name of Structure: _____

1. Choose three properties that your building materials need to have. Write the properties in the top row of the chart below.
2. On the left side of the chart, list the materials you are investigating. Add rows if needed.
3. In each box, write a ✔ or an X to show which materials have the properties you need.
4. After you have investigated all the materials, decide which ones would be best for your structure. List them at the bottom of the page.

	Properties		
Material	**1:**	**2:**	**3:**
1:			
2:			
3:			
4:			
5:			
6:			
7:			
8:			

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How Are Building Materials Joined Together?



Focus: Students explore how building materials are joined together to form structures.

Specific Curriculum Outcomes

Students will be expected to:

- 25.0 investigate ways to join materials and identify the most appropriate methods for the materials to be joined [GCO 1/3]
- 26.0 use appropriate tools in safely cutting, shaping, making holes through, and assembling materials [GCO 1/3]

Performance Indicators

Students who achieve these outcomes will be able to:

- identify several types of joints and fasteners
- explain why various fasteners are better suited to certain materials
- record their observations in a manner of their choosing

NOTES:

Attitude Outcome Statements

Encourage students to:

- work with others in exploring and investigating [GCO 4]

Cross-Curricular Connections

Math

It is expected that students will:

- describe 3-D objects according to the shape of the faces and the number of edges and vertices [3SS6]

English Language Arts

Students will be expected to:

- use writing and other forms of representation to explore, clarify, and reflect on their thoughts, feelings, experiences, and learnings, and to use their imaginations [GCO 8]

Getting Organized

Components	Materials	Before You Begin	Vocabulary
• Student Magazine pages 20–21 • IWB Activity 6	• sheets of construction paper • index cards (1 per student) • markers and crayons • large supply of Lego blocks • samples of various fasteners (e.g., glue, different kinds of tape, staples, twist ties, pipe cleaners, string, modelling clay, brass fasteners, Velcro, elastic bands, buttons, marshmallows) • samples of various materials (e.g., wooden sticks, straws, paper, stir sticks, fabric) • various tools (scissors, hole-punch, stapler, glue gun) • safety equipment for all students (goggles, aprons) • digital cameras (optional) • students' Science Journals • foam blocks • poster-making materials	• Prepare a collection of fastener samples and material samples for each group. • Prepare a collection of tools for each group.	• fastener • gusset • joint

Safety

- You may choose to have students wear safety goggles and aprons while they are working with the tools and fasteners in this lesson.
- Review appropriate safety rules with students before giving them access to any tools.

Science Background

- Because structures have more than one part, they inevitably have joints, or places where two parts are attached. Some joints are created permanently, such as by welding. Some joints are created with fasteners, such as nails.

Some non-permanent joints, such as hinges, allow one or more of the structure's parts to move while still remaining attached.

- The type of joint used depends on the purpose of the joint and on the material used in each part.

ACTIVATE

Joints and Fasteners



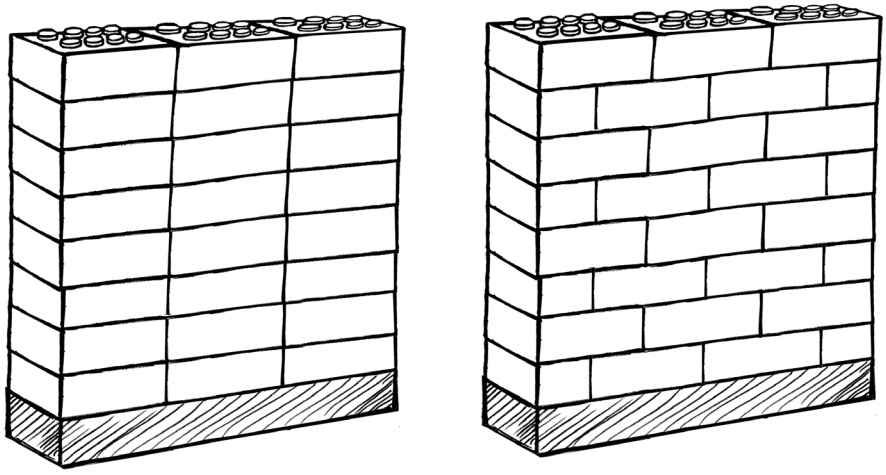
Write the word "joint" on a piece of coloured paper and tape it to the board. Ask students what word they can see in joint (join), and lead them to understand that a joint is a place where two or more parts of a structure are joined, or fastened together. Ask students how you formed a joint between the board and the piece of paper (you used tape as a fastener). Add the word "joint" to the Word Wall.

Write the word "fastener" on another piece of coloured paper and tape it to the board. Then tell the class that they are going to brainstorm other ways to fasten things together. Distribute index cards to all students and invite them to write or draw another kind of fastener (e.g., buttons, pushpins, shoelaces, staples, string). Students can be encouraged to explore the classroom for ideas, including the Curiosity Centre. Once students have filled in their index cards, they may attach them to the board with tape, under the word "fastener." Add this word to the Word Wall.

CONNECT

Lego Joints

Have students form groups of three. Give each group a large supply of Lego blocks and have students build a simple wall of three columns, set side-by-side on a long foundation block. It is important that students do not stagger the blocks, but align them one on top of the other, creating two long vertical joints. When their walls are done, groups should experiment with wiggling the foundation block and observing what happens to the wall. Then, groups can create another wall, this time staggering the blocks to create zigzagged joints. The wiggle test should produce very different results.



Ask:

- **Which kinds of joints are more stable: ones that go up in a straight line, or ones that are zigzagged? Why do you think so?**

Alternatively, you could have half the groups build the wall one way and the other half build it the second way. Ask students to wiggle the foundation blocks and compare their observations.





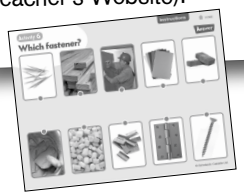
Pros and Cons

Invite students to read the text on pages 20–21 of the Student Magazine. Have students identify the kinds of joints and fasteners they see on the spread. Explain that the photo of the grey posts shows a gusset, which is a thick, flat piece of strong material that is attached to a structure at a joint. This makes the joint stronger. Add the kinds of fasteners students identify to the list on the board. Add the word "gusset" to the Word Wall.

Discuss how students would use fasteners such as rubber bands, paper clips, and glue. Ask:

- **What materials might you join with these fasteners?**

IWB Activity:
Challenge students to match each material or item to the fastener that could be used to fasten it using Activity 6: *Which fastener?* (see the Teacher's Website).



Go through the list of fasteners noted on the board and ask students to identify the pros and cons of each. For example, rubber bands are flexible but they can break. Mortar is very strong, but it is not flexible. Point out to students that fasteners have properties, just like building materials do. Ask them how they think they would choose the correct fastener for a joint they need to make. Allow for a short discussion.

Experimenting With Fasteners

Provide small groups with a variety of fasteners (e.g., glue, different kinds of tape, staples, twist ties, pipe cleaners, string, modelling clay, brass fasteners, Velcro, elastic bands, buttons, marshmallows), materials (e.g., wooden sticks, straws, paper, stir sticks, fabric), and tools (e.g., scissors, hole-punch, stapler, glue gun). Students could wear aprons and safety goggles during this activity, and cover their work area with plastic or paper towels. Students should be encouraged to try many different combinations of materials and fasteners. Groups may choose to join two pieces of one material together or two different materials together. Groups should choose an appropriate method to record their observations in their Science Journals.



Note: This activity may require an adult volunteer to provide supervision and assistance as needed.

CONSOLIDATE

3-D Forms

Have students break into pairs. Have each pair decide on a 3-D form they wish to create such as a cube, pyramid, cone, or dome. You may wish to set parameters on the forms, such as that they must have at least two types of building materials and/or at least two types of fasteners. Partners should



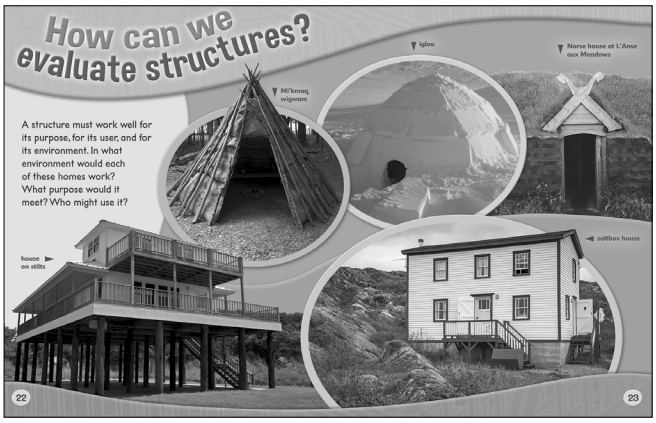
discuss and choose materials and fasteners, sketch a labelled diagram for their form in their Science Journals, and construct it. Pairs should be prepared to explain why they chose the kinds of materials and fasteners they did. Students could also research and construct models of traditional shelters of the Innu, Inuit, or Mi'kmaq. Foam blocks could be used to construct the domed structure of an igloo which requires no posts or beams for support.

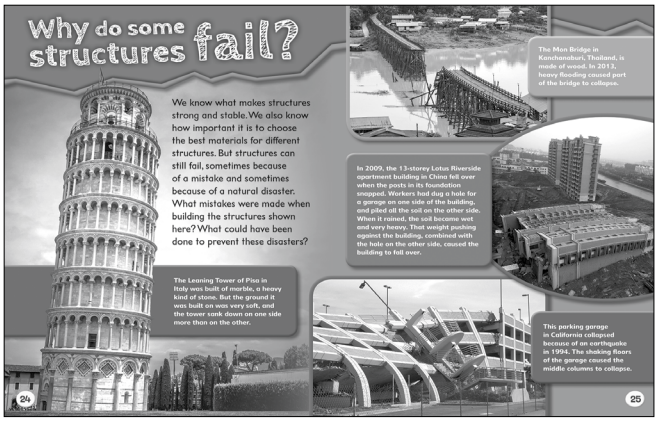
EXPLORE MORE

Fascinating Fastener Ads

Students can create a poster or a TV commercial that advertises a particular kind of fastener. The advertisement should include a list of the best materials to use with this kind of fastener, as well as its properties.

How Can We Evaluate Structures?





Focus: Students evaluate the effectiveness and appropriateness of structures, and design a model home.

Specific Curriculum Outcomes

Students will be expected to:

- 27.0 evaluate structures to determine if they are effective and safe, if they make efficient use of materials, and if they are appropriate to the user and the environment [GCO 1/3]
- 28.0 identify problems to be solved [GCO 2]

Performance Indicators

Students who achieve these outcomes will be able to:

- ask questions to help evaluate structures
- collaborate with others to design a model home that satisfies certain criteria

NOTES:

Attitude Outcome Statements

Encourage students to:

- work with others in exploring and investigating [GCO 4]

Cross-Curricular Connections

English Language Arts

Students will be expected to:

- communicate information and ideas effectively and clearly, and to respond personally and critically [GCO 2]
- use writing and other forms of representation to explore, clarify, and reflect on their thoughts, feelings, experiences, and learnings; and to use their imaginations [GCO 8]

Getting Organized

Components	Materials	Before You Begin	Vocabulary
• Student Magazine pages 22–25 • IWB Activity 7 **Literacy Place:** • *Tunnel Vision: Building an Underwater Tunnel* (Guided Reading, Level R)	• any version of *The Three Little Pigs* • various drawing materials (grid paper, sketch paper, rulers) • various model-building materials (modelling clay, blocks of wood, Lego bricks, foam blocks) • computers or tablets with Internet access	• Create a "bookbag" out of aluminum foil, using pipe cleaners for handles and adding any other necessary materials. • Invite an Elder or Indigenous Knowledge Keeper to visit the class.	• evaluate • failure

Science Background

- Structural failures are often due to a lack of planning for natural disasters, such as earthquakes, hurricanes, and floods. They can also be the result of shortcuts taken or mistakes made during the design and/or construction process, including mathematical errors, such as miscalculating the maximum load a structure can bear. This is why the testing stage of the design process is so important, as are experiencing failures during this stage. Failures can lead to an improved design.

Possible Misconceptions

- Students might believe that any failure is a sign of incompetence and a reason for self-blame. The examples in this lesson are of structures designed and constructed by professionals, which should show students that anyone can make mistakes. It is important that students understand the potential benefits of such failures, in that they can be studied by people who can then make improvements.

ACTIVATE

Judge It!

Ask students what it means to evaluate something (to judge it, to decide how good it is). Show students a bookbag you have made out of aluminum foil and pipe cleaners. Ask them how they might go about evaluating it. What questions would they ask about the bag? Record the questions they suggest on chart paper. If necessary, model asking questions such as:

- **What is the bag's purpose? Does it work for that purpose?**
- **Who will be using the bag? Will it work for those people?**
- **What are the properties of the materials in this bag?**
- **Were these materials the best ones to use?**
- **What materials could you use?**

CONNECT





Evaluating Structures

Introduce pages 22–23 of the Student Magazine and read the title question aloud: *How can we evaluate structures?* Discuss the term "evaluate" with students and explain that they will be analyzing the structures shown to determine their overall effectiveness. Add "evaluate" to the Word Wall.

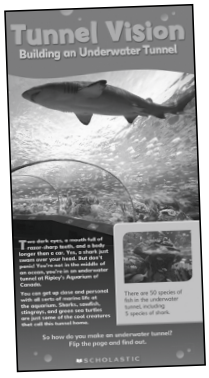
Have small groups each choose one of the shelters on the spread and answer the questions in the text for their shelter:

- **In what environment would the home work?**
- **What purpose would it meet?**
- **Who might use it?**

The Three Little Pigs

Read a version of *The Three Little Pigs* aloud. Then have students form small groups and ask them to evaluate each of the three houses in the story. Prompts for discussion might include:

- **Which was the strongest, and why?**
- **Was the material chosen the best material for that structure?**
- **Did the structure have a solid foundation?**
- **How could the other two houses have been improved?**



Literacy Place Connection:
Share *Tunnel Vision: Building an Underwater Tunnel* (Guided Reading, Level R) with students and discuss the process that was followed to build the tunnel. Invite students to evaluate the structures. Ask:

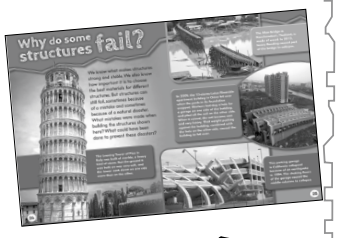
- **What was the purpose of the tunnel? Did it work for that purpose?**
- **Who will be using the tunnel? Will it work for these people?**
- **What are the properties of the materials used in this structure?**
- **Were those materials the best ones to use?**

CONSOLIDATE

Model Homes

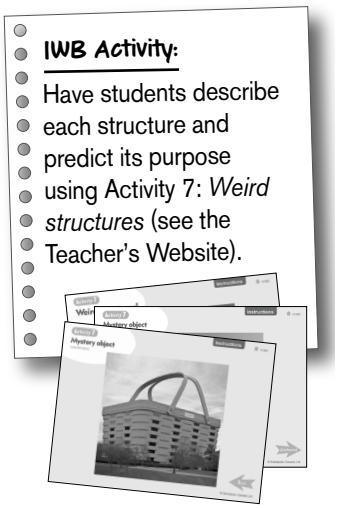
As a class, discuss the environment and climate where you live. Encourage students to brainstorm some of the building materials that are available in your area, and list them on the board. Then tell students that they are going to design a home that would be good for living in their area of the province.

Divide the class into small groups and have each group select a variety of drawing materials and building materials. Group members collaborate on a design, building materials, and fastening methods, and then draw a labelled sketch of their home indicating the materials and fasteners they chose. After the sketch has been approved, groups can build a model of their home using substitute materials, such as modelling clay or Lego bricks. Students can participate in a Gallery Walk to view other groups' labelled sketches and model homes.



Failed Structures

Have students look at the structural failures shown on pages 24–25 and read the text including the captions for each structure. Challenge students to suggest ways in which each failure might have been avoided. Students may choose one of the failed structures to research further and present their information to the class. Record any questions on the I Wonder Wall.



EXPLORE MORE

Indigenous Structures

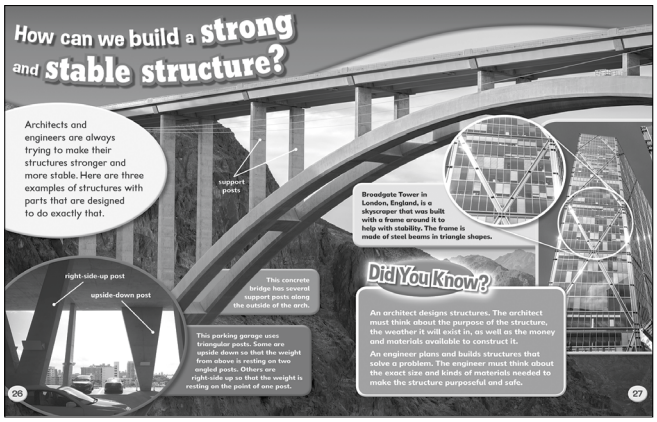
Have students construct models of different structures found in a local Indigenous culture. Students could discuss why they think the traditional Indigenous peoples used the materials they did or why they did not build houses similar to the ones we see today (or the log cabins of early European settlers).

An Elder or Indigenous Knowledge Keeper could be invited to talk about how local and natural materials were used to build various structures including homes, shelter, transportation devices, storage containers, bags, tools, etc. If possible, ask a member of the local Indigenous community to lead a session where students use local materials to construct a structure using traditional Indigenous knowledge.

Impossible Structures

Have students create an "impossible structure" in Minecraft (https://minecraft.net/en/) using the Creative mode. In this mode, players have access to an unlimited number of different types of blocks. Since the laws of physics do not apply in this game (towers can be built upside down, etc.), players can imagine and build structures that could not be built in the real world. Once students have built their structures, they can work in small groups to identify problems that the structures would have if they were actually built.

Design Challenge: Build a Structure



Focus: Students use the design process to build a strong and stable structure.

Specific Curriculum Outcomes

Students will be expected to:

- 29.0 identify materials and suggest a plan for how they will be used [GCO 2]
- 30.0 respond to the ideas and actions of others and acknowledge their ideas and contributions [GCO 2]
- 31.0 estimate measurements [GCO 2]
- 32.0 follow safety procedures and rules [GCO 2]

Performance Indicators

Students who achieve these outcomes will be able to:

- use the design process
- use a variety of sources for ideas
- acknowledge and respond to other people's ideas
- estimate measurements
- build a structure that will satisfy a set of given criteria

NOTES:

Attitude Outcome Statements

Encourage students to:

- show concern for their safety and that of others in carrying out activities and using materials [GCO 4]
- appreciate the importance of accuracy [GCO 4]

Cross-Curricular Connections

Math

It is expected that students will:

- demonstrate an understanding of measuring length (cm, m) by estimating length, using referents [3SS3]

English Language Arts

Students will be expected to:

- interpret, select, and combine information using a variety of strategies, resources, and technologies [GCO 5]

Getting Organized

Components	Materials	Before You Begin	Vocabulary
• Student Magazine pages 26–27 • IWB Activity 8 • *What Is the Design Process?* poster • BLM *Isometric Grid Paper*	• students' Science Journals • various building materials (e.g., cardboard boxes, paper towel rolls, newspaper, construction paper, card stock, chicken wire, fabric, plastic tubs) • various fasteners (e.g., different kinds of glue, different kinds of tape, staples, twist ties, pipe cleaners, string, modelling clay, brass fasteners, Velcro, elastic bands) • various tools (e.g., hand-held fans, scissors, hole-punches, staplers, glue guns, utility knives) • aprons and goggles for all students (optional)	• Ensure that the Reading Centre is stocked with several books about materials and structures. You may wish to cue tablets or computers to approved Websites showing various designs.	• design • construct

Safety

- You may choose to have students wear aprons and goggles while they are working with materials and tools.

Science Background

- Structural design criteria usually focus on the ability of a structure to support a certain load, withstand a certain amount of vibration, and withstand wind up to a certain speed.

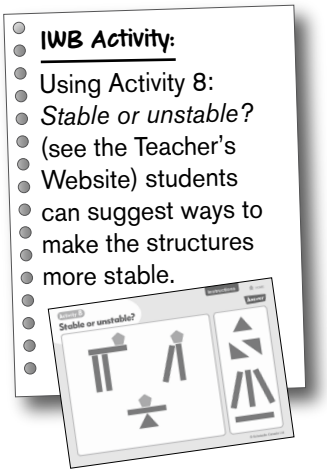
ACTIVATE



Adding Strength and Stability

Give students time to read the text and examine the images on pages 26–27 of the Student Magazine. Discuss the different methods used to ensure that these structures were strong and stable. Prompts for discussion might include:

- **What functions do different parts of the structure have?**
- **Which shapes and forms are providing strength and stability to the structure?**
- **Are the materials used suited to the purpose of the structure?**



CONNECT

Build a Structure



Tell students that they are going to design and construct their own structure. It can be a bridge, a tower, a skyscraper, a castle, a piece of furniture, or whatever else they can think of including structures related to the local Indigenous culture or an Indigenous culture elsewhere in the province. The challenge is that their structure must also be strong and stable. Ask students how they will determine if their structures are strong and stable then allow them time to set specific criteria for their structure (e.g., their structure will hold a certain load, or remain stable when shaken a certain number of times, etc.).

Display the *What Is the Design Process?* poster and review the steps with students. You can also use this time to review safety procedures for working with various tools.

Step 1: Identify a problem. Think of a solution. Make a plan.



Have students form small groups and begin the design process. Give groups time to brainstorm and discuss their design and to gather information and ideas. Sources could include books from the Reading Centre or elsewhere in the classroom, as well as approved Websites. Students should use their Science Journals to make notes (e.g., noting the problems they must solve with their design, listing the materials they will need). Emphasize the need for students to listen to and acknowledge every group member's ideas and contributions. Once each group has decided on a design, ask them to sketch their structure in their Science Journals.

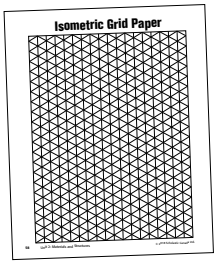
CONSOLIDATE

Build a Structure (continued)

Step 2: Gather materials. Build your solution.

Groups can now decide on the materials, fasteners, and tools they will need to build their structure. They can estimate the measurements of their structure to determine how much of each material and how many fasteners they will need. They can then gather the items from a central location, trying to take only the amounts they need. Materials may include cardboard boxes, paper towel rolls, newspaper, construction paper, card stock, chicken wire, fabric, and plastic tubs. Fasteners may include different kinds of glue, different kinds of tape, staples, twist ties, pipe cleaners, string, modelling clay, brass fasteners, Velcro, and elastic bands. Tools may include hand-held fans, scissors, hole-punches, staplers, glue guns, and utility knives. As each group gathers the tools it will need, encourage students to repeat any safety rules associated with the tools. Give students time to build the first version of their structure.

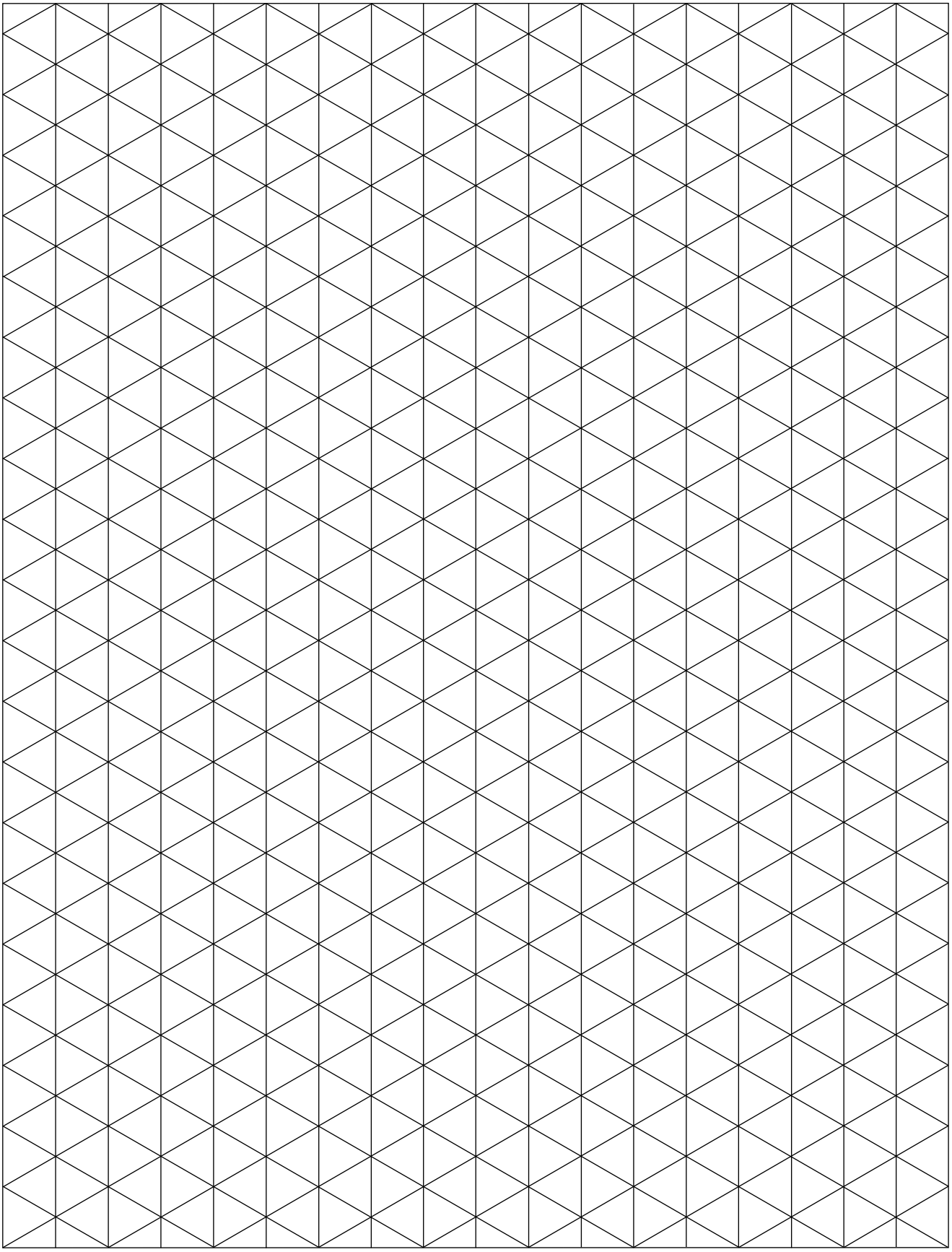
EXPLORE MORE



Isometric Sketches

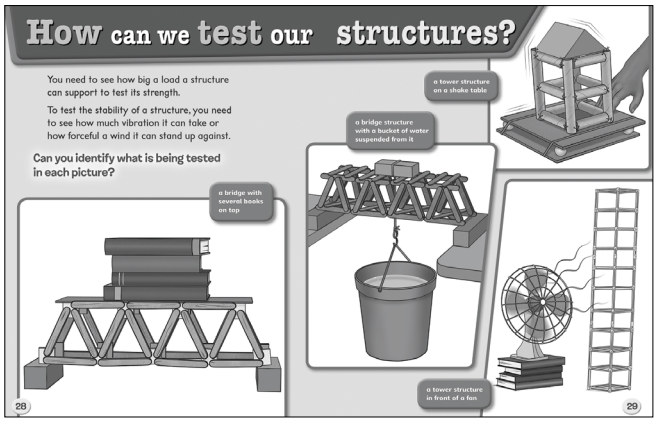
If possible, have students watch the Isometric Sketching video at http://pbskids.org/designsquad/video/what-isometric-sketching/. Provide students with copies of BLM *Isometric Grid Paper* and have them do their best to make an isometric sketch (a 3-D drawing) of their designed structure.

Isometric Grid Paper



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How Can We Test Our Structures?



Focus: Students test and evaluate their structures for strength and stability.

Specific Curriculum Outcomes

Students will be expected to:

- 33.0 test the strength and stability of personally built structures [GCO 1/3]
- 34.0 pose new questions that arise from what was learned [GCO 2]
- 35.0 compare and evaluate personally constructed objects [GCO 2]

Performance Indicators

Students who achieve these outcomes will be able to:

- establish testing criteria for their structure
- evaluate and modify their structure
- give useful feedback to others

NOTES:

Attitude Outcome Statements

Encourage students to:

- be open-minded in their explorations and investigations [GCO 4]
- be sensitive to the needs of other people, other living things, and the local environment [GCO 4]

Cross-Curricular Connections

English Language Arts

Students will be expected to:

- interact with sensitivity and respect, considering the situation, audience, and purpose [GCO 3]
- create texts collaboratively and independently, using a variety of forms for a range of audiences and purposes [GCO 9]

Getting Organized

Components	Materials	Before You Begin	Vocabulary
• Student Magazine pages 28–29 • BLM *TAG Feedback* (1 per group)	• students' Science Journals • binder covers or squares of plywood (2 per group) • large elastic bands (2 per group) • same-sized large marbles or small balls (4 per group) • poster-making materials		

Science Background

- The ability of a structure to carry a load and maintain stability depends on its design, its materials, and its joints.

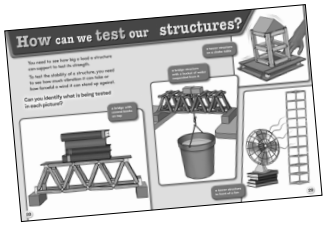
ACTIVATE

Bridge-Building Contest Video

Remind students that the structures they are building need to be strong and stable. Tell them you are going to show a video about a bridge-building contest. One of the ways the bridges are evaluated is to see how much of a load can be held in a bucket suspended from the bridge. Show students the second half of the video (beginning at about 4:00 minutes) at https://www.youtube.com/watch?v = clHqbMBdn_E. This section shows several structures that fail the load-bearing test. You can stop the video at various points to discuss what part of each structure failed.

Note: You may wish to mute or lower the volume on the video.

CONNECT



Testing Structures

Have students look at the illustrations on pages 28–29 of the Student Magazine and read the text. Discuss the methods of testing shown, and which types of structures they are best suited for.

Tell students that they will now work in their groups to decide how they will test the strength and stability of their own structures. Allow time for groups to decide on their method of testing. Ideas may include any of the methods shown on pages 28–29 of the magazine.

CONSOLIDATE

Build a Structure (continued)

Step 3: Test your solution. Evaluate your solution.

Groups continue to follow the design process by testing, evaluating, and modifying their structure as necessary. Encourage students to test their structure to the point of breaking so that they have an opportunity to consider how to modify and improve it. Prompts for discussion might include:

- **Did your structure work the way you intended?**
- **Did your structure perform as well as you planned?**
- **Are there things you could do better?**





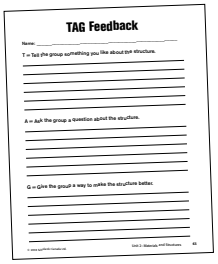
Make sure students are taking notes on their actions and observations in their Science Journals. Encourage students to add any new questions to the I Wonder Wall.

Shake Tables

Groups may choose to build a simple "shake table" to test the stability of their structure. Students place two same-sized boards or binder covers on top of one another. Then they stretch a large elastic band over each end, about 2 cm from the edges. Students can then carefully insert a large marble or small ball between the boards in each corner, about 2.5 cm from the edge. Encourage students to refer to the illustrated shake table on page 29 of the Student Magazine as they build their own.

If students need more help building their shake table, see the video at http://www.raftbayarea.org/ideas/Shake%20Table.pdf# for a demonstration.

Gallery Walk


TAG Feedback

Name: _____

T = Tell the group something you like about their structure.

A = Ask the group a question about the structure.

G = Give the group a way to make the structure better.

Near the end of class time, have students do a Gallery Walk to examine the ongoing work of other groups. Each group should travel together, moving clockwise around the room. At its first stop, have each group fill out a copy of BLM *TAG Feedback* (Tell the group something good, Ask the group a question, Give the group a way to improve the structure) and leave the completed sheet for the designers. Have each group give you the feedback sheet that was left for their structure before they leave the class.

EXPLORE MORE

Safety Poster

Students can create a safety poster outlining the safety procedures and rules they followed for the design challenge. The completed posters can be displayed within the classroom.

TAG Feedback

Name: _____

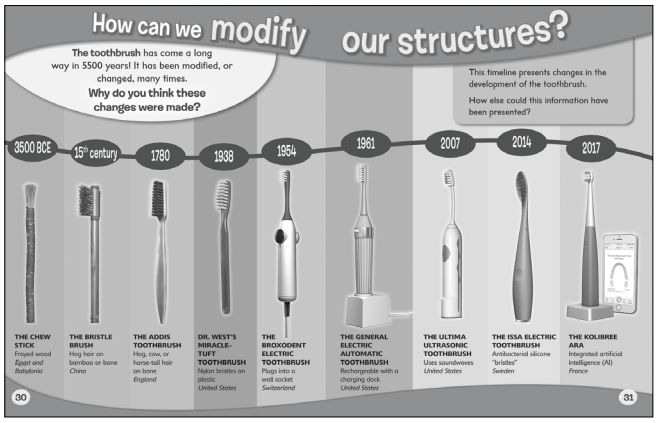
T = Tell the group something you like about the structure.

A = Ask the group a question about the structure.

G = Give the group a way to make the structure better.

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How Can We Modify and Present Our Structures?



Focus: Students use feedback from others to improve their structure and write a collaborative report.

Specific Curriculum Outcomes

Students will be expected to:

- 36.0 identify ways of modifying a structure to increase its strength and stability [GCO 1/3]
- 17.0 communicate procedures and results [GCO 2]

Performance Indicators

Students who achieve these outcomes will be able to:

- consider the contributions and ideas of others
- make modifications to improve their structure
- collaborate on a group report

NOTES:

Attitude Outcome Statements

Encourage students to:

- consider their own observations and ideas when drawing a conclusion [GCO 4]

Cross-Curricular Connections

English Language Arts

Students will be expected to:

- communicate information and ideas effectively and clearly, and to respond personally and critically [GCO 2]
- use a range of strategies to develop effective writing and representing and to enhance their clarity and effectiveness [GCO 10]

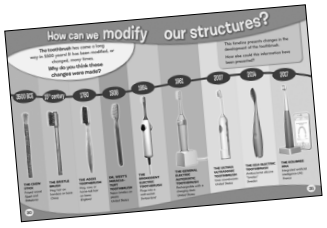
Getting Organized

Components	Materials	Before You Begin	Vocabulary
• Student Magazine pages 30–31 • IWB Activity 9	• cellphone • images of telephones over time • groups' *TAG Feedback* forms from the previous class • students' Science Journals • report-writing materials • poster-making materials	• Gather images of several telephone designs from the past century, either in hard copy or digitally.	• modification • modify

ACTIVATE

Structures Change Over Time

Display a common structure that has changed over time such as a cellphone. Ask students if telephones have always looked like this. Show them some images of telephones over time, and ask students what they notice (the size and shape of phones have changed; new functions have been added).



History of the Toothbrush

Allow students time to examine pages 30–31 of the Student Magazine. Read the title question aloud to the class: *How can we modify our structures?* Then encourage students to read the text and discuss why they think these changes to the toothbrush were made. Draw out the ideas that change can come as a result of failure or bad design, as a response to changing demand, as an opportunity to use new materials and technology, etc.

Invite students to discuss with a partner other ways the information could have been presented.

CONNECT

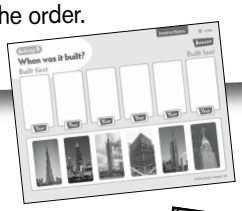
TAG Feedback

Tell students that changes or modifications to something often come from outside advice or ideas. Give each group the *TAG Feedback* form that was left for their structure during the Gallery Walk in the last teaching plan. Groups can discuss the questions on the forms and the suggestions for improving their structure then they can then implement any changes they think will make their structure stronger or more stable, and retest the structure.

CONSOLIDATE

IWB Activity:

Invite students to use Activity 9: *When was it built?* (see the Teacher's Website) to sequence a set of buildings by the year they were built. Discuss any "clues" that may have helped students to decide on the order.





Build a Structure (continued)

Step 4: Share your solution and what you learned.

Invite students to share their revised structures and have a whole-class discussion about some of the modifications the groups made to their structures. List these on a chart as they are described. Modifications may include

- **making the foundation larger or reinforcing it,**
- **adding cross-beams to create triangles,**
- **reinforcing joints, and**
- **shortening posts and/or beams.**

Group Reports

Have groups revisit the notes they wrote in their Science Journals during the design process. Each student in the group will write a brief report on one or two steps of the process, and then the group will consolidate all reports into one. Students can create reports in any format they choose. Consolidated reports should include the successes and failures the group had, any problems they encountered and the solutions they came up with, and any further suggestions for how to improve the structure.

EXPLORE MORE

Structures Fair

Students can hold a "Structures Fair," to which they invite other classes and family members. In preparation for the fair, groups may wish to make their structure more attractive (without compromising its strength and stability) and should create one or two posters with information from their combined report. During the fair, students should be available and ready to answer questions about their structure and the process undertaken in its development.

WRAPPING UP THE UNIT



Revisit any remaining questions posted on the I Wonder Wall and have students discuss answers in small groups or with a partner. If there are questions that cannot be answered at the time, these can remain on the I Wonder Wall for students to research independently. Discuss what students have learned about materials and structures, including how they can be described; how their materials, joints, and fasteners are chosen; and how they can be made strong and stable.

Specific Curriculum Outcomes Checklist

Name: _____ Date: _____

Rating: 1 – not evident; 2 – with assistance; 3 – mostly on own; 4 – on own consistently

Specific Curriculum Outcomes	Rating and Observations
19.0 identify shapes and forms that are part of natural and human-built structures [GCO 1/3]	
20.0 investigate and describe ways different shapes and forms help provide strength and stability [GCO 1/3]	
21.0 follow a simple procedure [GCO 2]	
22.0 identify and suggest explanations for patterns and discrepancies in objects and events [GCO 2]	
23.0 describe the properties of some common materials and evaluate their suitability for use in building structures [GCO 1/3]	
24.0 identify the most useful method of sorting [GCO 2]	
25.0 investigate ways to join materials and identify the most appropriate methods for the materials to be joined [GCO 1/3]	
26.0 use appropriate tools in safely cutting, shaping, making holes through, and assembling materials [GCO 1/3]	
27.0 evaluate structures to determine if they are effective and safe, if they make efficient use of materials, and if they are appropriate to the user and the environment [GCO 1/3]	
28.0 identify problems to be solved [GCO 2]	
29.0 identify materials and suggest a plan for how they will be used [GCO 2]	
30.0 respond to the ideas and actions of others and acknowledge their ideas and contributions [GCO 2]	
31.0 estimate measurements [GCO 2]	
32.0 follow safety procedures and rules [GCO 2]	
33.0 test the strength and stability of personally built structures [GCO 1/3]	
34.0 pose new questions that arise from what was learned [GCO 2]	
35.0 compare and evaluate personally constructed objects [GCO 2]	
36.0 identify ways of modifying a structure to increase its strength and stability [GCO 1/3]	
1.0 pose questions that lead to exploration and investigation [GCO 2]	
2.0 communicate using scientific terminology [GCO 2]	
6.0 use appropriate tools [GCO 2]	
17.0 communicate procedures and results [GCO 2]	

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My Design

Name: _____

The problem:
My solution and my plan:
How I will test my solution:
How my solution worked:
How I will share my solution and what I learned:

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Student Self-Assessment of Design Process

Name: _____

Check the box that applies to each statement.

	I'll do better next time	**Okay**	**Awesome**
Step 1			
I identified the problem.			
I chose a solution and made a plan.			
Step 2			
I built my solution.			
Step 3			
I tested my solution.			
I evaluated my solution.			
Step 4			
I shared my solution and what I learned.			

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Teacher Assessment of Design Process

Name: _____ **Date:** _____

	1	2	3	4
Initiating and Planning				
• identifies a problem to be solved				
• thinks of a possible solution to the problem and makes a simple plan				
• identifies materials and suggests a plan for how they will be used				
Performing and Recording				
• carries out the plan/follows a simple procedure				
• uses appropriate tools				
• makes and records observations				
• estimates and records measurements				
• constructs a prototype				
• follows safety procedures and rules				
Analyzing and Interpreting				
• proposes an answer to the initial problem				
• identifies and suggests explanations for patterns and discrepancies in objects and events				
• poses new questions that arise from what was learned				
• compares and evaluates personally constructed objects				
Communicating and Teamwork				
• communicates while exploring and investigating				
• communicates using scientific terminology				
• communicates procedures and results				
• responds to ideas and actions of others and acknowledges their ideas and contributions				

Comments:

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Design Process Rubric

	Level 1	Level 2	Level 3	Level 4
INITIATING AND PLANNING	works on a problem set by the teacher or group	identifies a problem to solve but it may not be practical	identifies a practical problem to solve	identifies a practical problem to solve and gives some criteria for solving it
	suggests a solution to the problem and, with prompting, offers ideas about procedure	suggests a solution to the problem and makes a simple plan	suggests several possible solutions to the problem and chooses one; makes a simple plan	suggests several possible solutions to the problem that address the criteria; chooses the best solution and makes a simple plan
	with prompting, identifies some materials which could be used to carry out the plan	identifies some materials and describes how they could be used to carry out the plan	selects appropriate materials and describes how they will be used to carry out the plan	selects appropriate materials to carry out the plan and explains reasons for choice
PERFORMING AND RECORDING	with prompting, carries out the plan/follows a simple procedure	carries out the plan/ follows most of a simple procedure	carries out the plan/follows a simple procedure	carries out the plan/ follows a simple procedure, making adjustments as necessary
	with prompting, uses some appropriate tools with assistance	selects and uses common tools	selects and uses some appropriate tools	selects and uses all appropriate tools
	makes simple observations using senses and, with prompting, records observations in provided charts or drawings	makes some relevant observations using senses and records observations in provided charts and drawings	makes relevant observations using appropriate senses and records observations using a suitable method	makes relevant, detailed observations using appropriate senses and records observations and chooses an effective method for recording observations
	needs help to estimate measurements and, with prompting, records simple measurements	estimates measurements but units may not be appropriate and records measurement which may be incomplete	estimates measurements using appropriate units and records measurements accurately	consistently estimates measurements using the most appropriate units and records measurements accurately in a variety of ways
	constructs a prototype but does not follow the plan	constructs a prototype according to the plan but the device may not be usable	constructs a usable prototype according to the plan	constructs a usable prototype according to the plan with modifications for improvement
	needs help to follow safety procedures and rules	needs occasional prompting to follow safety procedures and rules	follows most safety procedures and rules	follows all safety procedures and rules and explains why they are needed

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Design Process Rubric (Continued)

	Level 1	Level 2	Level 3	Level 4
ANALYZING AND INTERPRETING	with prompting, says whether or not a solution works	says whether a solution works in terms of some simple criteria	evaluates and explains the effectiveness of a solution in terms of simple criteria	evaluates and explains the effectiveness of a solution in terms of a broad range of criteria
	with prompting, identifies some patterns and discrepancies in objects and events	identifies and suggests simple explanations for some patterns and discrepancies in objects and events	identifies and suggests explanations for most patterns and discrepancies in objects and events	identifies and suggests clear explanation for patterns and discrepancies in objects and events
	with prompting, identifies some new questions but they may not be on the same topic	identifies some new questions on the same topic	identifies some new questions that arise from the solution	identifies new questions that arise from the solution and suggests how they could be solved
	with prompting, makes simple suggestions for changes to improve the device/solution	suggests some practical changes to improve the device/solution	suggests and makes practical changes to improve the device/ solution	makes effective changes to improve the device/ solution
COMMUNICATING AND TEAMWORK	willingly asks for help and accepts help from other group members	makes suggestions to group members as to what should be done	communicates with group members, sometimes with problems	communicates and works effectively with group members
	understands some scientific terminology but rarely uses it	understands simple scientific terminology but does not always use it correctly	usually uses scientific terminology appropriately	consistently uses scientific terminology appropriately
	with prompting, describes the solution and some of the procedures	communicates basic information about the solution and most of the procedures	communicates most of the information about the solution and procedures	accurately communicates the information about the solution and procedures
	listens to others and learns from their observations	listens to others and learns from their observations, and draws on their language use	considers and responds to the ideas of others and learns from their observations and descriptions	considers and responds to the ideas of others and applies the observations and descriptions to their own ideas and understandings

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Additional Resources

Non-fiction Books

13 Buildings Children Should Know by Annette Roeder (Prestel, 2009)

Bridges! Amazing Structures to Design, Build and Test by Carol A. Johmann (Turtle Back Books, 1999)

Bridges and Tunnels: Investigate Feats of Engineering with 25 Projects by Donna Latham (Nomad Press, 2012)

How a House Is Built by Gail Gibbons (Holiday House, 1990)

Look at That Building! A First Book of Structures by Scot Ritchie (Kids Can Press, 2011)

Rosie Revere's Big Project Book for Bold Engineers by Andrea Beaty (Abrams, 2017)

Sky Boys: How They Built the Empire State Building by Deborah Hopkinson (Dragonfly, 2012)

Skyscrapers! Super Structures to Design & Build by Carol A. Johmann (WorthyKids/ideal, 2004)

The Story of Buildings: From the Pyramids to the Sydney Opera House and Beyond by Patrick Dillon (Candlewick, 2014)

Twenty-One Elephants and Still Standing by April Jones Prince (HMH Books for Young Readers, 2005)

Picture Books

A House Is a House for Me by Mary Ann Hoberman (Puffin, 2007)

Iggy Peck, Architect by Andrea Beaty (Abrams, 2010)

Pop's Bridge by Eve Bunting (HMH Books for Young Readers, 2006)

Roberto: The Insect Architect by Nina Laden (Chronicle Books, 2000)

Rosie Revere, Engineer by Andrea Beaty (Abrams, 2013)

The Magnificent Tree by Nick Bland (Scholastic, 2013)

The Most Magnificent Thing by Ashley Spires (Kids Can Press, 2014)

The Three Little Pigs (any version)

The Three Little Pigs: An Architectural Tale by Steven Guarnaccia (Abrams, 2010)

Too Much Glue by Jason Lefebvre (Flashlight, 2013)

Websites for Students

DPBS: Building Big
www.pbs.org/wgbh/buildingbig

- Shapes Lab: http://www.pbs.org/wgbh/buildingbig/lab/shapes.html
- Materials Lab: http://www.pbs.org/wgbh/buildingbig/lab/materials.html
- Loads Lab: http://www.pbs.org/wgbh/buildingbig/lab/loads.html
- Forces Lab: http://www.pbs.org/wgbh/buildingbig/lab/forces.html
- Glossary of Engineering Words: http://www.pbs.org/wgbh/buildingbig/glossary_head.html#P

PBS: Kids Design Squad

- Cardboard Playhouse: http://pbskids.org/designsquad/video/cardboard-playhouse/
- What Is Isometric Sketching?: http://pbskids.org/designsquad/video/what-isometric-sketching/

Wonderopolis (Search "materials" and "structures")
www.wonderopolis.org

Websites for Teachers

Giant Ant Hill Excavated
https://www.youtube.com/watch?v = lFg21x2sj-M

How It's Made: Bricks
https://www.youtube.com/watch?v = SbKvhHzn4hQ

How It's Made: Hardwood Plywood
https://www.youtube.com/watch?v = LrCt5kJwcyw

IdeaPark – Webs of Wonder (Search "structures")
https://www.exploreideapark.org/Resources.aspx

Let's Talk Science: Marshmallow Structure
http://www.letstalkscience.ca/programs-resources/activities/item/how-tall-can-you-build-a-marshmallow-structure-that-will-support-weight.html

Load-Bearing Test:
https://www.youtube.com/watch?v = clHqbMBdn_E

Minecraft:
https://minecraft.net/en/

Shake Table:
http://www.raftbayarea.org/ideas/Shake%20Table.pdf#

Tacoma Narrows Bridge Collapse
https://www.youtube.com/watch?v = lXyG68_caV4

Dear parents and caregivers,

We are about to start a new unit in science in which we will be exploring materials and structures. Through a variety of hands-on activities and investigations, your child will be learning about various structures and their parts, what materials are best suited to particular structures, what makes structures strong and stable, and how to make their own strong structure.

You can talk to your child at home about materials and structures. Walk with your child around your home and help him or her to identify different structures (including furniture and household items) and various materials (including those used to build your home). Encourage your child to identify what materials were used to make each structure, and why.

You can plan some activities with your child to focus on materials and structures. For example:

- Ask your child to choose a material, and then discuss what would happen if certain structures around your home were made of that material.
- Go on a scavenger hunt with your child to find several structures made of the same material, then discuss why that material was chosen for those items.
- Build various structures with your child, using playing cards, Lego bricks, wooden blocks, etc. and discuss how to make the structures more stable and stronger.

You can also invite your child to look for various types of joints and fasteners around your home. Discuss with your child why certain joints and fasteners are used for certain materials and structures.

To ensure a wide range of experiences and make connections between this topic and your child's world, he/she may choose to bring one or more personal items to school for exploration during in-class activities. These items will be returned home once explorations are completed. To determine whether the item(s) is appropriate please contact me, your child's teacher.

Sincerely,