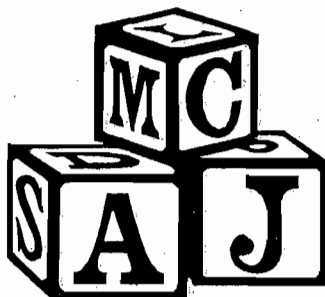


Building Structures

Instructional Guide



Pre-K - Physical Science Unit

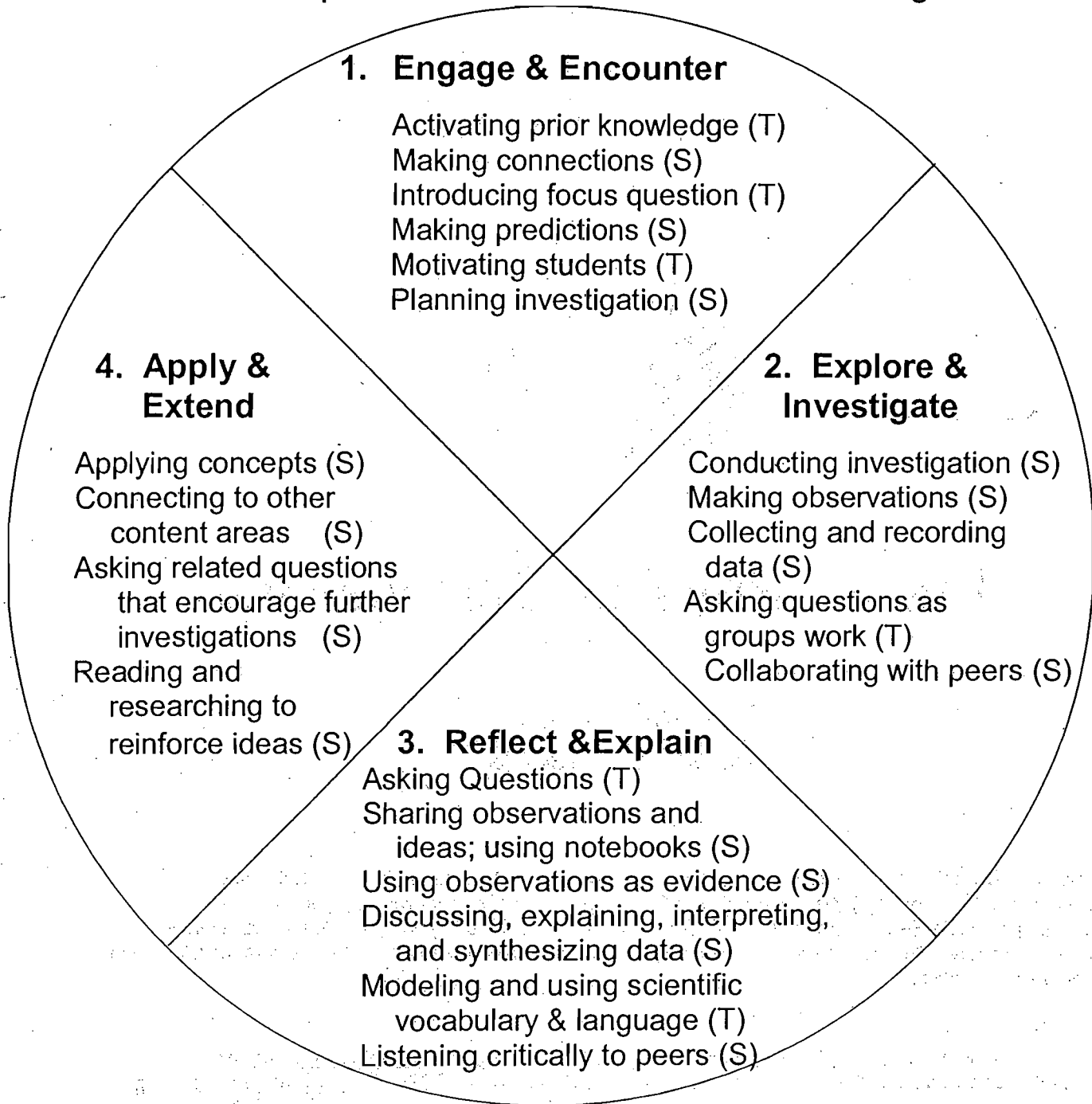
- Tips for Success
- Support Materials

This Instructional Guide supplements the *Building Structures* Teacher's Manual (©2004 Education Development Center, Inc.). The Instructional Guide has information that will help you meet the Washington State Early Learning and Development Benchmarks, bring rigor, and teach the science unit more effectively. The modifications are based on state standards, research, feedback from teachers, and input from scientists.

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Materials Questions: Contact the Science Materials Center at 545-7024, smc@seattleschools.org
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Seattle Public Schools Learning Cycle

Key Components of the Inquiry-Based Science Lesson
Sequence to Promote Student Learning



T: Teacher Facilitates S: Student Behavior

Science Concepts in Building Structures Unit

Different building materials have different properties

- Building material, size, shape, texture and other properties affect a structure's strength and stability

Forces: gravity, tension, compression

- Structures must be built to resist the pull of gravity
- Some parts of the structure are squeezed together—this is compression which affects different materials differently
- Some parts of the structure are pulled apart—this is tension (particularly evident with the straws and connectors)

Certain designs are stronger and more stable than others

- Stable structures must be balanced and the forces must be in equilibrium so that it will not tip, break or collapse
- Strong structures need a strong foundation and a low center of gravity (e.g. wider at the bottom and narrower at the top)

Building Structures Goals

- Build with a variety of different materials.
- Experience the ways forces (gravity, compression, tension) affect a structure's stability.
- Build an understanding about how the properties of materials affect a structure's stability.
- Develop science inquiry skills including wondering, questioning, exploring, investigating, discussing, reflecting, formulating ideas and generalizations.
- Develop scientific dispositions including curiosity, eagerness to find out, and open mind, and delight in being a builder.

Purpose of Open Exploration

For Students:

- Starts with children's natural play
- Gives children opportunities to wonder about, notice and explore
- Gives children the support, materials and time they need to begin their exploration
- Gives children a chance to pursue their own interests
- Gives children the opportunity to discover the properties of the different building materials

For Teachers:

- Opportunity to observe student interests
- Get ideas for science talks and small group activities
- Look for places to introduce vocabulary and ideas
- Guide students in discovering scientific concepts

Flow of Open Exploration

Step 1: Introduce students to building structures

- Share previous building experiences and introduce the building materials
- Choice time for students to explore the different materials
- Sharing building experiences and ideas (science talks)

Step 2: Ongoing exploration and reflections

- Continue block exploration
- Encourage reluctant builders
- Begin using science notebooks to record work
- Continue science talks highlighting new ideas and challenges that arise from block exploration
- Add new books, photos, pictures to the block area
- Begin weekly small group block exploration with teacher

Tips and Ideas

Open Exploration Step 1: Introducing Building Structures

Science Talks can be done with a whole group or a small group. If discussions are done in small groups, consider coming back together as a whole group and sharing ideas as a class at a later point.

Science Talk 1: Introduction to the Unit

- Have one example of each type of block and gather students in the block area or other discussion area
- Ask students:
 - What have you made out of blocks? Can you tell us about it?
 - What did it look like?
 - What kinds of blocks did you use?
- Record student's ideas on a chart labeled "What We Made with Blocks." Include both words and illustrations on your chart.
- Post charts where students can see them in the block area.
- Following this discussion, give students a chance to explore the different types of blocks. As students work, observe the types of structures they build and any challenges students face. This will give you ideas for the direction to take future science talks.

Science Talk 2: Rules for Builders (See page 23 in manual).

- Begin by asking students what they have been building in the block area.
- Say: Today we are going to talk about how we can be safe in the block area. Let's see if we can come up with some guidelines, or rules, for the block area.
- Ask students:
 - Show us a safe way to take blocks off the shelves.
 - Show us a safe way to take a structure apart without knocking it over.
 - Show us how you can put the blocks away safely.
 - What else can we do to be safe and fair in the block area?
- As students demonstrate ideas, help the group formulate a statement that can be put on the "Rules for Safe and Fun Block Play" Chart.
- Post the chart in the block area.

Children's Block Play

- As students begin block play, observe and document the following things:
 - What are they building?
 - Which children are involved?
 - Are children choosing to explore alone or with peers?
 - Are they placing the blocks on flat surfaces and building things like roads?
 - Are they stacking blocks on top of one another?
 - Are they making bridges by placing blocks across vertical supports?

- Are they mixing block types in their structures, or only using one type of block?
- **Sample questions to ask as students engage in block play:** (Not all builders will want to talk with you as they are working, do not force the conversations if students wish to focus on their building without interruption)
 - What are you building?
 - What is this part?
 - What blocks are you using for the walls? What about the roof?
 - Does your building have a door? Windows?
 - What would happen if you took this block away?
 - What would happen if you used a different kind of block?
 - What shape/color block are you going to put here?
 - Have you ever seen a building like this one? Where? Who used it?
 - How is yours different?
 - Why do you think your structure fell over? What will you do differently next time?
- **Types of documentation** (Documentation is critical to future science talks. Discussions will be much richer if students have a physical object or picture to remind them of their structures).
 - Photograph student work
 - Teacher illustration of student structure
 - Student illustration of student structure
 - Saving the structure itself

Tips and Ideas

Open Exploration Step 2: Ongoing Open Exploration

Ways to Encourage Children to Build and Maintain Interest:

- Share a photograph of a student's structure. Place photos of students' structures in the building area for students to use as plans.
- Acknowledge students ongoing exploration by holding informal science talks with individuals or small groups during work time. For Example:
 - Which blocks are you choosing to build with? What are you building?
 - What do you think will happen if you add more blocks?
 - What might happen if we you took this block away?
 - What could you try next time to keep your structure from falling over?
 - What shape block are you looking for?
 - What would happen if we used two or three different kinds of blocks to build a structure?
- Add new kinds of blocks to the building area. You might introduce the new materials with these questions
 - What do you think you might build with these?
 - How are these blocks or materials like some of the others you use?
 - What do you think these blocks or materials will be good for building?
- Add props to the block area such as toy cars and animals, or books about castles, barns, or other buildings. Ask:
 - These horses need a home that will keep them dry when it rains. What could we build for them?
 - How will the horses get in and out of the structure?
 - Which blocks might you use to build a castle?
 - Which blocks would be good for making a road to drive on?
- Invite reluctant builders to build with you or with a partner.
- Assign reluctant builders to the block center during one or two choice times.
- Declare an "all girls" day in the block area if mostly boys are choosing blocks. Put a chair in the block area so children can choose to observe the building play.

- **Introduce the Science Notebooks:**
 - Begin by asking students if you can draw a picture of their structure. Model looking carefully at the structure and making an illustration to represent it on paper.
 - Use the clipboards for students to begin making illustrations of their structures on paper or their science notebooks.
 - Ask students to tell you about their drawings and show you the parts of their structures in their drawings.
 - Students can dictate to you what they would like to record about their structure and you can add their language to their notebook.
 - Students can use the word bank to add words to their illustrations.
 - Many students find it easier to make more careful illustrations and observations if they use only pencil in their drawings.

- Encourage students to notice other's structures. Discuss the similarities and the differences in children's structures and building strategies. Encourage them to try out new ideas that they like.

- **Hold Walkabouts.** At the end of a building period, before clean up, have students leave their structures up so that other students may walk around and look at them. Students may interview the builder about their structure. You can ask about things you have noticed such as:
 - I noticed that your roof fell in a few times. How did you get it to stay up?
 - Can you show us how you made this long block balance?
 - What shape is your doghouse? How many blocks did you use to build it?

Science Talk Ideas:

Science Talks can be done with a whole group or a small group. If discussions are done in small groups, consider coming back together as a whole group and sharing ideas as a class at a later point.

- Choose a block. Have student generate a list of words to describe its properties. **Make words cards to add to the word bank**

- Show a photograph of a Student's Structure.
 - Glue the photograph on a large sheet of paper.
 - Ask student to describe what they observe (see).
 - Write student's observations on the paper.
 - Add the words that the students generate to a word bank.

- Use a student drawing as a blue print.
 - Choose a child's representation of their structure.
 - Ask: What does this drawing show us about ____'s structure?
 - Work together to use the drawing to rebuild the structure.
 - Introduce students to the term "blueprint" and explain that this is a plan used for building.

- Add students' drawings and picture of buildings to the block area for students to use during block play as blueprints.
- Choose two different blocks. Have the students tell you how they are the same and different. Create a Box and T-Chart to display in the block area. Use the word "Both" to help think of ways that the blocks are the same. When writing about differences, be sure to talk about the same property for both blocks (e.g., color, shape, texture).

Example:

Foam Block and Wood Block

Both have corners
 Both can be stacked
 Both have the same shape—rectangle

Foam Block	Wood Block
Soft	Hard
Blue	Brown
Light	Heavy
Squishy	Can't be squished

- Discuss a student challenge or problem. For example:
 - Yesterday I was watching Lily build a house. She put one of these rectangle blocks on top of this one, but it fell off. How could we get this block to balance?
 - Have blocks in the discussion area so that students can try out their ideas.

Purpose of Focused Exploration

To give students:

- opportunities to investigate specific questions in more depth
- support, materials, and time they need to deepen their exploration
- opportunities to work cooperatively to solve a problem and communicate ideas
- opportunities to develop conceptual understanding over time
- time to think critically about what they have been observing

ELEMENTS OF FOCUSED EXPLORATION

- Exploration focuses on building towers and enclosures
- Walkabouts are used as a strategy for sharing and analyzing buildings
- Books, posters, neighborhood walks, and visiting experts are used to stimulate building and thinking
- Two- and three-dimensional representation is used to reflect on work
- Science talks are used to share experiences and ideas

Tips and Ideas:

Focused Exploration: Towers

Big Idea: The stability of structures is affected by the way materials are put together (design) and the types of materials used.

You may notice that some children will remain engaged in open exploration and will continue to explore broadly. Open exploration and focused exploration can occur simultaneously.

Science Talk 1: Introducing the Towers Exploration

- Share experiences building so far. You might use the following questions:
 - What have you built that is tall?
 - What kinds of blocks did you use?
 - How did you build it?
 - How tall did it get?
- Show a picture of a student's structure that is tall, or gather the group around a tall structure left standing. Ask:
 - Tell me about this structure?
 - What do you think makes it so strong?
 - How did you keep it from falling down?
- As children share, record their ideas about tall structures.
- Introduce a building challenge: Try to build the tallest structure you can using one kind of block. Ask and record:
 - Which blocks do you think will be best for making tall towers? What makes you think that?
 - How will you design your tower? What makes you think that will make a strong and tall tower?
- Revisit your building guidelines and discuss any additions that might need to be made when building tall structures. Consider how you will handle building above their heads. One idea is to have a special chair or stool students can stand on, and use hard hats from the home center. Discuss with students how to do this safely.

Children's Block Play

- As students begin block play, observe and document the following things:
 - The care with which children add blocks to their towers.
 - If they choose blocks that are likely to balance.
 - If they restructure parts of their structures to make them more stable.
 - What do students do if their structure falls? Do they rebuild? Do they learn from the experience and change their design?

- **Sample questions to ask as students engage in block play:** (Not all builders will want to talk with you as they are working, do not force the conversations if students wish to focus on their building without interruption)
 - What block are you going to put on next? What made you choose that one?
 - Tell me about what you are building?
 - Can you make it taller?
 - Have you ever seen a building like this? Where have you seen it?
 - What did you do to keep it from falling?
 - What do you think would happen if we build this tower with a different kind of blocks?
 - What do you think would happen if we took this block out of the tower?
 - What could you add to your tower to make it more stable?

Conduct Weekly Walkabouts

- Before clean up, have students leave their structures standing and gather together as a whole group.
- Walk around and look at the different structures.
- Give builders a chance to talk about their structures.
- Other students can ask questions of the builders.
- Ask questions such as the following to encourage discussion:
 - Which blocks are the best for building tall towers? Which structure makes you think that?
 - Which blocks are not great for building tall? Which structure makes you think that?
 - If you wanted to build a tall tower, what shape blocks would you choose? Why would you choose that shape?
 - What do the tall towers look like at the top? What about the bottom?
 - What do you think keeps the chimney from falling off the roof?
 - How do you think the builders made the tower so it wouldn't fall over?

Encourage Building of Tall Towers

- If some students are not engaged with the focused exploration, ask about what they are building and offer suggestions and encouragement for how to make them taller.
 - Could you add a chimney to your house? How would you do that?
 - Can you make a lookout tower for your fire station?
 - Let's look at this book about castles. Would you like to add a tower to your castle?
- Add book, photographs, or drawings of tall structures to the building area.
- Cut long, thin pieces of paper for making illustrations of tall buildings.
- Add string or yarn that children can cut to show how tall their towers are.
- Invite reluctant builders to build with you or with a partner.
- Make building tall towers part of your small group time.

Science Notebooks

- Continue to encourage students to record their structures in their science notebooks. Encourage them to use the word bank to add labels to their illustrations. Take dictation and record students descriptions and thinking about their structures in the science notebooks.
- Use the following questions to help students with their illustrations:
 - What shape is your tower? Can you draw that shape in your notebook?
 - Juan started by drawing the bottom block, and then the one on top of it, all the way to the top. Would you like to try that?
 - How many blocks are in your tower? How many block are in you picture? Did you draw them all?
 - Tell me about your drawing. What part does this show?
 - What shapes did you use in your drawing? Where are those shapes in your tower?
 - The blocks in your tower are tipping to the side. Is that what happened when you built your tower? How did you keep the blocks from tipping over?
 - What else could you add to your scientific illustrations to show what your structure looks like?
 - Is there a word you would like to add to your scientific drawing? Can you find the word in the word bank?

Science Talk Ideas for Building Towers:

- **Bring photos or drawings of student's structures and discuss the different designs.**
 - Ask the following questions about the photo and record students thinking:
 - Tell us about this structure. Do you think this is as tall as this tower could go before falling down? What makes you think that?
 - I see that you placed the blocks on their flat side. What do you think might have happened if you'd used the thinner side of each block?
 - Can you tell us about the pattern in your tower? How do you think the pattern helped to make the tower tall?
 - This is the tower you built after your first one fell over. How did you build this one so that it could stay up?
 - Add new vocabulary that comes up to the word bank.
 - Add photos and drawing to the building center for students to use as "blueprints" in their block play.
- **Look at a Book or Poster of a Tall Building**
 - Look at the image and facilitate the following discussion:
 - Have you ever seen a building like this? Tell us about it?
 - How would you build a tower like this one in the picture?
 - What types of blocks would you use?
 - What shape blocks would you use?
 - How would you keep it from falling over?
- **Discuss a Student Challenge or Problem.** For example?
 - I noticed ___ was trying to build a tower using these foam blocks, but it kept falling over. How could we design a foam tower so that it is strong and stable?
 - Be sure to have blocks in the discussion area so that students can try out their ideas.
- **Discuss ways to measure and compare towers.**
 - Count the number of blocks in the different towers.

- Have children stand next to the towers and measure with their bodies.
- Provide string or yarn to use to measure and compare towers.
- **Compare two building materials. Which is best for making tall towers?** Encourage students to work together to build similar towers with the two types of blocks.
 - How are the foam blocks and the wood blocks the same? How are they different?
 - I want to find out if these foam blocks, or the wood blocks will make a taller tower?
 - What could we do to try to find out?
 - Which tower is the tallest? How do you know?
 - Which tower is the strongest? How do you know?
 - If you wanted to build a very tall tower, which blocks would you use? Why would you choose those blocks?
 - What do you think would happen if we used both kinds of blocks to build a tower?
 - Encourage students to try out ideas during work time.
- **Discuss balance and stability. What designs help tall towers stay standing?**
 - Create a class chart: "What Makes a Tower Tall and Stable." Ideas can be added to the chart over time.
 - If you want to build a strong tower, what are some good ways to start?
 - What are some of the ways you kept the tower from falling down? Does someone have a different idea?
 - How should you place the blocks on top of each other?

Tips and Ideas:

Focused Exploration: Enclosures

Big Idea: The forces of gravity, compression, and tension affect the stability of the walls and how large a roof-load they can bear.

You may notice that some children will remain engaged in open exploration and will continue to explore broadly. Open exploration and focused exploration can occur simultaneously.

Science Talk 1: Introducing the Enclosures Exploration

- Share experiences building so far. You might use the following questions:
 - Have you ever build a house out of blocks?
 - What did it look like?
 - How big was it?
- Show a picture of a student's structure that has an enclosure, or gather around an enclosure left standing. Ask:
 - Tell me about this building?
 - Does it have different rooms? Does it have a door?
 - How does the roof stay on top?
 - How did you keep the roof from falling down?
- As children share, record their ideas about enclosures.
- Show students some materials you have collected for building a roof (cardboard cut to different sizes, hollow or paper blocks, flat unit blocks boards, etc.)
- Introduce a building challenge: Try to build a structure that has a roof and some space inside like a house, barn, garage for cars, or other building. Ask:
 - What do you think you will build today?
 - Will it have different stories or different rooms?
 - Who or what will go inside it?
 - Will it stay dry if it rains?

Children's Block Play

- As students begin block play, observe and document the following things:
 - Are students using the materials to build enclosures?
 - Are they building walls that are strong enough to hold up a roof?
 - Are they building corners that resist being pushed apart when the roof goes on?
 - Are they adding supports to their buildings before the roof goes on?
 - Are they including door and windows in ways that keep the enclosure from collapsing?

- **Sample questions to ask as students engage in block play:** (Not all builders will want to talk with you as they are working, do not force the conversations if students wish to focus on their building without interruption)
 - What happened when you used the cardboard as the floor on this second story?
 - I noticed that you put Kapla blocks on top of your foam roof. Why did you choose those blocks?
 - What do you think would happen if the walls were built with the foam blocks instead of the wooden ones?
 - What do you think would happen if the roof were made out of wooden blocks instead of cardboard?
 - What do you think would happen if you made a window in this wall?
 - What could you use to add a door to your structure?

Conduct Weekly Walkabouts

- Before clean up, have students leave their structures standing and gather together as a whole group.
- Walk around and look at the different structures.
- Give builders a chance to talk about their structures.
- Other students can ask questions of the builders.
- Ask questions such as the following to encourage discussion:
 - What kind of building is this?
 - Have you ever seen or been in one like it?
 - How did you make the walls?
 - How did you make the roof?
 - What happened to the corners when you added the roof?
 - What would happen if we took this block out and made a door?
 - What do you think would happen if we tried to make this roof with a heavier block? A lighter block?
 - Have you seen a roof like this before? Where have you seen it?
 - What do you think holds this roof up?
 - What block could you take away and still have the structure stand up? What block could you take away that will make the whole structure collapse?

Encourage Building of Enclosures

- If some students are not engaged with the focused exploration, ask about what they are building and offer suggestions and encouragement for how add enclosures.
 - Tell me about what you are making? Can you make some tunnels for your car to go through?
 - You've made a bed for your dog; can you make a house for him too?
 - Your building reminds me of this picture in the book. Could you add a roof like this one?
- Add book, photographs, or drawings of enclosures to the building area.
- Invite reluctant builders to build with you or with a partner.
- Make building enclosures part of your small group time.

Science Notebooks

- Continue to encourage students to record their structures in their science notebooks. Encourage them to use the word bank to add labels to their illustrations. Take dictation and record students descriptions and thinking about their structures in the science notebooks.
- Use the following questions to help students with their illustrations:
 - What shape is your structure? Can you draw that shape in your notebook?
 - Which part of you structure will you draw first?
 - Will you start drawing--at the top or the bottom?
 - How many blocks are in your building? Can you draw that many in your notebook?
 - Can you show me the door in your illustration? Where is the door in your building?
 - What shapes did you use in your illustration? Where are those shapes in the house you built?

Science Talk Ideas for Building Enclosures:

- Bring photos or drawings of student's structures and discuss the different designs.
 - Ask the following questions about the photo and record students thinking:
 - Tell us about his structure.
 - How did you build the walls?
 - What happened when you added the roof?
 - What shapes do you think make the best roofs? What makes you think that?
 - How did you build the windows?

- Add new vocabulary that comes up to the word bank.
- Add photos and drawing to the building center for students to use as “blueprints” in their block play.
- **Look at a Book or Poster of an Enclosure**
 - Look at the image and facilitate the following discussion:
 - Have you ever seen a building like this? Tell us about it?
 - How would you build an enclosure like this one in the picture?
 - What types of blocks would you use?
 - What shape blocks would you use?
 - How would you keep the roof from falling?
- **Discuss a Student Challenge or Problem.** For example?
 - I noticed ___ was trying to build a roof using these wood blocks, but it kept pushing the walls down. How could we design the walls so that they can support the roof?
 - Be sure to have blocks in the discussion area so that students can try out their ideas.
- **Introduce students to the idea of building structures to withstand wind.**
 - Introduce this idea by reading or telling the story of the “Three Little Pigs”. Ask:
 - Why do you think the wolf was able to blow down the straw house and the stick house but not the brick house?
 - What do you think would happen if the brick house had been built with foam blocks instead?
 - Which of our blocks do you think you would choose to make a house that could not be blown down?
 - What if you wanted to make a house to blow down?
 - Try out a few students’ ideas, and then encourage students to investigate further on during work time.
 - Consider making straws available for students to use.
- **Compare building materials. Which are best for making an enclosure?**
 - Which blocks are best for building big houses? Why do you think so?
 - Which blocks are best for building strong walls?

- Which are best for big roofs? For strong roofs? How did you find that out?
 - What was good about using foam blocks?
 - How did you keep your structure from collapsing? Can you show us?
 - What do you think would happen if you used square blocks instead of rectangle blocks for the walls?
 - Which blocks would you use to make a building with lots of windows?
 - Encourage students to continue to try out ideas during work time.
- **Discuss balance and stability. What designs make strong structures?**
 - Create a class chart: "What Makes an Enclosure Strong" Ideas can be added to the chart over time.
 - If you want to build a strong building, what would you use for the walls?
 - What shapes do you think make the best roofs?
 - What do you do to keep the roofs from falling in?
 - How do you build your walls? How do you build your corners? How do you build your roof?

Building Structures Recommended Books

Author:	Title:
Barton, Byron	Building a House
Cooper, Elisha	Building
Crosbie, Michael	Arches to Zigzags: An Architecture ABC
Crosbie, Michael	Architecture Shapes (Board Book)
Dorros, Arthur	This is My House
Dupre, Judith	Skyscrapers
Keith Duquette	The House Book
Gibbons, Gail	How a House is Built
Gibbons, Gail	Up Goes the Skyscraper!
Hayden, Kate	Amazing Buildings (DK Readers Series)
Hayward, Linda	Jobs People Do: A Day in the Life of a Builder
Hutchins, Pat	Changes, Changes
Jackson, Thomas Campbell	Hammers, Nails, Planks and Paint: How a House is Built
Jeunesse, Gallimard	Houses: A First Discovery Book
Kalman, Bobbie	Everyday Structures From A-Z
Korman-Fontes, Justine	Building the Skyscraper
Macaulay, David	Building Big, Unbuilding
MacDonald, Fiona	Homes
Morris, Ann	Houses and Homes
Nelson, Peter	Tree houses: The Art and Craft of Living Out on a Limb
Richards, Jon	Shapes and Structures
Smith, Kathryn	Frank Lloyd Wright: America's Master Architect
Simon, Seymour	Lets Try It Out with Towers and Bridges
Slaymaker, Melissa Eskridge	Bottle Houses the Creative world of Grandma Prisbey
Steltzer, Ulli	Building an Igloo
Weber, Rebecca	Building With Shapes
Wilkinson, Philip	Building (Eyewitness Book Series)
Williams, John	Houses and Homes
Wood, Tim	Houses and Homes