Unit Overview

LOCAL HOUSE BUILDING

Enduring Understandings

Basic skills of building a house: weaving roof thatch, construction, tying techniques
Basic understanding of extending and predicting patterns
Proportional measurements
Algebraic thinking

Knowledge

Basic knowledge students need to build a house
Mathematical concepts they need to excel in school

Skills

Extending and predicting
Working with word problems
Weaving thatches
Identifying and naming shapes
Tying techniques
Working with patterns
Using local measurements
Solving mathematical problems

Rationale

Knowing how to build and replace houses is extremely important in the Outer Islands of Yap because of storms and natural disasters. Children need to learn the knowledge and skills, which includes understanding the culture and mathematics of the process.

Goals

By the end of the five lessons, students will be able to create house models that are put together correctly with the right part in the right place and are tied securely. Securely means the model can hold together without falling apart when moving it around. At the same time, the students will engage in learning grade-appropriate mathematical concepts and skills.

Essential Questions

Why do we need to learn about the local house construction?
What are the basic knowledge and skills needed in the construction of local houses?
What are the mathematics skills needed in local house construction.
How can we connect our local activities and practices to the learning of grade appropriate mathematical concepts?

Background to this Unit

Cal Hachibmai created this unit because house building is one of the most essential areas of knowledge in the Outer Islands of Yap. This region is prone to bad weather and frequent storms. Children can benefit greatly from the knowledge of the elders: understanding their culture and history, learning how mathematics is used to solve problems, and gaining practical construction skills.

Assessment

The teacher observes students' participation, process and progress as they develop and apply specific skills and knowledge. The teacher asks specific questions to confirm learning and assigns writing and initiates conversations to support learning process (e.g., reflection, knowledge).

Lesson One

ROOF THATCH WEAVING

Focus:

Roof Thatch Weaving

Patterns

Measurement

Objectives: *Students will*

- weave correctly at least one roof thatch and at the same time be able to use the proportional measurements.
- practice identifying patterns, and creating and working with tables to predict and extend patterns.

Materials Needed:

Coconut palm leaves (one for each student)

Knives to cut the leaves

Pencils

Roll of string

Notebooks

A completed model of a house or a picture

Teacher Activities	Student Activities
1.1. Tell a short story about the importance of knowing how to build a house. Use either the prepared story (in resources folder) or make up one.	*1.1 Listen and take notes. Ask questions.*
1.2. Connect the story to the lessons that will follow: Emphasize importance of learning basic skills to build houses. Explain the overall objective — to build a good house model. Explain that they will create the criteria for judging their model. Explain that the mathematical concepts they learn helps them excel in school.	*1.2 Listen and take notes. Ask questions.*
1.3a. Guide students to create the criteria for what is a "good house model": • weaving thatch roof correctly • identifying patterns from the thatch weaving • transferring weaving patterns onto their tables • extending the pattern in their tables correctly • using prediction skills • applying their knowledge of proportional body measurements	*1.3a. Discuss (in groups) the question "What makes a "good" house?"*

Teacher Activities	Student Activities
1.3b. Show students model (or picture) of model that follows criteria (1.3a). Observe and take notes of key points of students' discussions. Guide class discussion for students to share their ideas.	*1.3b. Create criteria for judging a good house.*

Steps for the teacher/expert

A. Prepare for weaving:
- Arrange for expert house builder to come to help students.
- Gather materials: strings, knives, palm leaves, coconut leaves

B. Model the different types of local or body measurement used for roof thatch, e.g., *sepaiu*, *selobe*, *sengaf*.
Measure using the string.

C. Have students use their palm leaf to practice measuring.
After a few minutes, tell them to use the 3 local measurements (in A) and mark off 3 different sections on their palm leaf.
Cut each student's leaf into 3 parts according to the marks.

D. Give each student a complete coconut palm leaf.

E. Using the *sepaiu*"length measurement, split the leaf part through the mid rib and model the simplest pattern of thatch weaving (one over, next under, one over and next under) while students observe.
Encourage them to pay close attention to the weaving patterns.
Redo the *modeling* while students follow along.

1.4. Model how to weave roof thatch or invite an expert to model how to weave roof thatch, or utilize the culture teacher at the school for that purpose. Model the next complex weaving process for the students and then have them practice. Follow the same steps in E. Show at least two types of weaving roof thatch. Encourage students who can weave their own thatch individually to help others practice the weaving process.	*1.4 . Review -use local units to measure the length of the thatch they will weave.* *Follow teacher steps C-E.* *Place the leaf face down on either the floor or on the lap.* *Watch and practice process.* *Observe, then practice the next type of weaving.* *Pay attention to the patterns in the weaving process.* *Observe and practice; ask for assistance as needed*
1.5. Have students refer to their woven thatch to find and talk about the patterns they find, e.g., the way the leaves are woven on top and underneath each other. Help them explore and discuss in groups or as a class, encouraging them to use their own words to tell each other the pattern each finds, e.g., "These leaves go over and under, over and under and so forth."	*1.5. Identify the patterns used on each type of weaving and talk about them.*

Teacher Activities

Student Activities

Preparation for Mathematics Principles

Materials: Sample weaving patterns (leaves from 1.5); pencils and notebooks

Assistance: Arrange for expert house builder to help students with their practice.

1.6. Have students represent with numbers any of the patterns they find.

Show one or two examples and then let students work:

e.g., One leaf over, one leaf under, one leaf over etc. can be translated into 1, 2, 1, 2, 1, 2, where the 1 represents the over and 2 represents the under etc.

One leaf over, two leaves under, one leaf over, two leaves under can be translated to 1, 2, 2, 1, 2, 2, 1, 2, 2, and so forth.

Encourage students to explore and record patterns they find.

1.6 Examine the patterns of in the woven leaves.

Translate patterns they find into numbers. Write the numbers down on paper:

E.g., write the patterns as 1, 2, 1, 2…or 1, 2, 2, 1, 2, 2…and so on.

Explore and discuss.

1.7a. Direct students to use the numbers they recorded from pattern translations.

1.7a. Create tables up to 3 or 4 terms.

Sample Table:

Term	1st	2nd	3rd	4th	5th	6th	10th	15th…
# of leaves	1	2	1	2	?	?	?	?…

Guide them to create tables like the one above: the terms are in the top row and the pattern is in the bottom row represented by the numbers they recorded.

Have them create tables with up to 3 or 4 terms. Show examples.

1.7b. Encourage students to observe different patterns and create tables that tell about the patterns.

1.7b. Create more tables that tell about patterns.

1.7c. Have students extend tables up to three or four more terms and then predict the number that will occur under each term without actually filling in the missing terms and patterns, e.g., What number occurs as the 10th term, or the 15th term and so forth?

Encourage students to discover and explore ways of finding out pattern numbers without always filling all the numbers through the sequence from the start to the end term.

Show examples before directing students to work in groups or individually.

1.7c. Extend and Predict: Using a table, extend the patterns they identify and predict what will come in the 10th, 15th, 20th term. Then compare predictions to the weavings.

Teacher Activities	Student Activities
1.7d. Encourage students to discuss with peers whatever they discover from the above activity. Guide students to observe and talk about the relationships between their tables and the weaving pattern on the roof thatch and about how they identify missing patterns.	*1.7d. Observe and discuss.*
1.7e. Have students work on formula or sentences that will proof their predictions of the next number in their pattern.	*1.7e. Create open sentences or formula and test their predications.*
1.8. Have the students share and talk about the tables of terms and patterns they created. Have them choose a table with three terms for presenting to the whole class. Guide students to show the whole class their tables and the roof thatch pattern from which they created the table. Have the whole class predict the next term, the 10th term, 20th term and the 25th term, or any other term they choose to present. Encourage students to discover ways to explain their ideas so the other students can understand. There are no right or wrong answers so encourage students to share their ideas. Invite them to ask each other questions or clarifications.	*1.8. Discuss the tables with each other (in groups of 3-4).* ***Suggestion:*** *Students create more tables that identify, extend and predict patterns or terms.* *They then choose a table and present it to the whole class.*

***Students create open math problems and formula to test their predictions, e.g.

T + P = NP

Term plus **Pattern** equals **Next Pattern**

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Lesson Two

TYING TECHNIQUES

Focus

Tying Techniques

Patterns

Materials Needed

Twine string

Sticks

Pictures of different tying

Objectives: *Students will*

- learn how to tie 2 or 3 stick together securely.
- be able to create their own tying pattern.
- create pattern tables and proof formulas to proof their predictions.

Teacher Activities	Student Activities
2.1. Make connections to the previous lesson. Introduce the concepts they will learn and practice: different tying techniques and related mathematical concepts. Pass out materials needed for the activity. Each child should have some pieces of stick and some pieces of string.	*2.1. Listen and ask questions to review the previous lesson.*
2.2. Show the students the pictures of different tying. (See resources) Talk about the importance of knowing how to tie things securely and appropriately so the house will not fall apart.	*2.2. Examine and observe different kinds of tying techniques.* *Ask questions. Take notes.*
2.3. Demonstrate the simplest form of tying two pieces of stick securely while the students follow along. As soon as some of the students learn the first tying technique, demonstrate another one. Encourage the students to observe the different patterns in the knots. Some knots will form a diamonds, triangles and/or squares.	*2.3. Watch and then practice tying two or three pieces of stick together (in groups of individually).*

Teacher Activities	Student Activities
2.4. Have students move into groups of 2-4 to create their own tying patterns (diamond, triangle or square), reminding them to be sure the knots are securely fastened. Have them talk about the patterns they are creating. Help students practice together, and have faster learners help the others.	*2.4. Experiment with the sticks and twine and talk aloud the process (in groups of 2-4).* *Create their own patterns by tying together two or three pieces of stick using the string.*
2.5. Direct students to form different groups (optional). Ask them to examine the knots and answer the questions in the box below or those pre-made by the teacher. (See resources.)	*2.5. Identify and create mathematics problems (in same or different groups).* *Solve the problems.* *Give the problems to other groups to solve and compare answers.*
Sample Questions If you roll the string diagonally from left to right three times and right to left five times, what is the total roll of the string around the sticks? If you do that same pattern with two other connections, what are the total rolls of strings around all the sticks' connections? What happens if you change the pattern? What happens if you have even number connections? …and so on	
Ask students to come up with their own mathematics problems from tying knots and then find solutions. Encourage them to use their prior knowledge of mathematical operations to find solutions.	
2.6. Ask students to share their patterns as well as their mathematics problems with each other. Encourage the other students to ask questions.	*2.6. Choose one of the patterns.* *Show and explain to the class why they chose that pattern and how they created the pattern.* *Talk about the mathematics problems they created out of that pattern and explain how they solved the problems.*
*** Students create pattern tables and proofing formulas or open sentences of their predications.	

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Lesson Three

CONSTRUCTION BASICS

Focus

Construction of Basic Model Parts

Introduction to Shapes

Word Problems

Materials Needed

Twine string

Sticks

Paper and pencils

Objectives: *Students will*

- learn techniques for tying things together securely and apply them to the model.
- practice working with and solving word problems.

Teacher Activities	Student Activities
3.1. Make connections to the previous lesson. Introduce the concepts they will learn and practice: different tying techniques and related mathematical concepts.	*3.1. Listen and ask questions to review the previous lesson.*
3.2. Direct students into 3 or 4 groups. Guide groups to examine the completed model (or picture) and to create the shapes they need to assemble their models of the major parts of the house: columns, major beams, and rafters. Encourage students to pay special attention to the shapes and the pattern when working on the model. Encourage students to use different types of local measurements learned in previous lessons or create a measuring technique or tool. When students have completed a general structure of the model let students move to step 3.3.	*3.2. Use their tying skills from the previous lesson to tie together the major parts of the house models: columns, major beams and rafters.*
3.3. Direct students to examine the structure they've just completed and share observations in their groups. Have them look for shapes in their structure and draw the shapes. Ask students to create names for the shapes they have drawn. • They use their own word or a combination of words (phrase) to identify each shape. • The names should be personally meaningful and should uniquely describe the shapes (preferably in vernacular.)	*3.3. Look for shapes in the model and in their groups talk about them.* *Draw the shapes in their structure on paper.* *Create names for the drawn shapes, using their own words.*

"Name the Shape Game"

- Teacher asks groups any question, and the first group to answer correctly becomes the 'caller' to start the game.
- The group calls out their name for one of the shapes.
- Other groups draw the shape. The first group to draw it correctly takes their turn to be the 'caller' - naming one of their shapes for the other groups.
- If no group draws the correct shape the same group adds hints or calls out another shape name.
- Groups continue taking turns calling out the names of shapes.

Teacher Activities	Student Activities
3.4. Explain how to play the "Name the Shape" game.	*3.4. Play the "Name the Shape" game (in the same groups).*
3.5a. Ask the groups to examine any of the models. Go over sample word problems (See below and make additional questions as needed and also see resources.)	*3.5a Examine the model. Listen to sample word problems and ask questions as needed.*
3.5b. Put students into groups of 2-4. Guide students as they create and solve their own sensible mathematics (word) problems. Encourage them to make a variety of word problems.	*3.5b. Create various mathematics problems for the model.*

Sample Word Problems (3.4)

If you decide to double the length of the existing model, how many rafters will you need?

If you have 5 rafters on one side of the model house, how many rafters will you need to complete the whole house?

What happens to the width of the existing model if you double the length? Why?

If you want to double the length of the model but don't have any extra rafters, what do you do? Why?

…and so on.

"Points for Problems" Game

for lessons 3.6 and 4.6

Rounds

- Each group takes a turn to share one problem, explaining the problem and showing the solution.
- Other groups ask questions and make comments (e.g., give corrections).
- The judge assigns points based on the rules.

Repeat rounds until all the problems are presented or time is up.

If a group runs out of problems, they are 'out' but can still ask questions for points.

Game Rules

The teacher or selected member from each group becomes the judge and point keeper.

Points are awarded as follows:

- 5 points = another group corrects the presenting group
- 4 points = a group answers a bonus question sensibly and with completeness.
- 3 points = the problem is sensible
- 2 points = the problem is partly sensible
- 1 point = presentation of a problem

The group with the highest point total wins.

Teacher Activities	Student Activities
3.6. Explain the rules of the 'Points for Problems' game. (See above.) Note that one 'round' means all groups present one after the other. Direct each group to take their turn sharing their word problems by explaining them and showing how to solve them. Encourage other group members to ask questions. Ensure that points are assigned for each group After all the groups share their first problem, they move to their second problem ("round two"). Continue…	*3.6. Ask questions to understand the game and rules.* *Present the group's first problem, explaining it and then solving it.* *Respond to questions and suggestions.* *Present the group's second problem.* *Continue…*
3.7. Review the word problems and help students discuss their learning related to the lesson.	*3.7. Talk about their learning, asking questions and making comments to confirm their understanding of the mathematics principles in this lesson.*

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Lesson Four

MODEL OF A HOUSE

Focus

House Building

Identification, Naming and Working with Shapes

Objectives: *Students will*

- complete the house model.
- be able to name, differentiate, and solve problems related to different shapes found in house building.

Materials Needed

Twine string

Sticks

Pencils

Notebooks

Teacher Activities	Student Activities
4.1. Make connections to the previous lesson. Introduce the concepts they will learn and practice, as they continue to work with a house model.	*4.1. Listen and ask questions to review the previous lesson.*
4.2 Direct students to continue working in their groups (2-4 in a group) to complete the structure of the house model. Encourage students to use the measurement types and tying techniques they learned from previous lessons. Encourage them to pay attention to additional pattern and shapes.	*4.2 Work to complete the house model.* *Add all the purlins and the thatches if necessary.*
4.3. Ask students in their groups to examine completed models and talk about any mathematical ideas they find, e.g., patterns, shapes operations and so forth. Walk around to facilitate discovery as students work together. Answer any questions.	*4.3. Examine the completed model,.* *Talk in their groups (of 2-4) about any mathematical ideas they find, e.g., additional pattern and shapes, additions, subtractions.*
4.4. Ask students to share their discussion with the class. Facilitate group presentations.	*4.4. Participate in a group presentation to share their discussion with other groups.*

Teacher Activities

Student Activities

4.5a. Assign students to groups so they can play a game to review their discussions and presentations in 4.4.

Explain the game is “Points for Problems” with different problems.

Give samples of the kinds of problems they must create.

4.5a. Listen and ask questions.

Sample Word Problems (4.5)

- If you you decide to double the length of the existing model, how many rafters will you need?
- How does the measurement of the rafters or the king post affect the whole building? What about the main beams vs the secondary beams?
- If you have a house with 6 feet length and 2 feet height and your roof thatch length is 1 foot, approximately how many thatches do you need to cover one side of the building? Why?
- If you are asked to build another house with an additional half measurement of length, how much material would you need? How would you figure this out?
- What is a three sided figure that you can see when you stand in the front or back of the house?

4.5b. Direct students to prepare their problems and solve them.

Encourage students to create problems with fractions, e.g. the number of rafters compared to the number of purlins.

Encourage them to include problems from measurements.

4.5b. Prepare problems to use in the game, including questions that use fractions and measurements.

4.6. Play the game. (See game rules in lesson 3.)

4.6. Present the questions. Ask other groups questions and offer corrections.

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Lesson Five

MAKING LINKS

Focus

Important Aspects of House Construction

Connection to Mathematics

Materials Needed

Twine string

Sticks

Objectives: *Students will*

- go on a field trip to observe a real house.
- apply their knowledge of house building and mathematics.

Teacher Activities	Student Activities
5.1. Introduce and connect the lesson to previous lessons.	*5.1. Listen and take notes. Ask questions.*
Tell the students the purpose of the field trip.	*Make necessary preparations.*
Explain that they have an opportunity to apply knowledge of the model to an actual house and to make comparisons.	
Discuss expectations for the field trip, for example (as follows)	

Guidelines for the field trip

- Use general common sense rules to stay safe.
- Be prepared by bringing pencils and notebooks or paper to write down observations and questions related to
  - the physical descriptions of the house
  - observations of how mathematical principles have been applied
  - details of interest

Explain that when they return, they will use their notes to discuss and to practice more mathematics problems based on the field trip.	*Ask questions to fully understand expectations.*
Invite student questions to be sure they are prepared for the field trip.	

Teacher Activities	Student Activities
5.2. Discuss the field trip experience with students. Ask them what they thought was important. Focus on the mathematical ideas they saw and make links to their classroom learning. Have students write down whatever they discussed or remembered to be important.	*5.2. Discuss the field trip and ask questions as needed.*

Plenary for Unit: Local House Building

Review the unit by asking specific mathematics questions (see below). Talk about answers. Ensure students understand the mathematics principles connected to the answers.	*Discuss the questions and answers.*

Sample Questions [and Answers]

What is a three sided figure that can be found when you stand in the front or back of the house?

[Answer: a triangle]

If you find 7 rafters on one side of the building, how many would you think would be on the other side?

[Answer: 7 rafters]

If you have a house with 6 feet length and 2 feet height with your thatch roofs length of 1 foot, approximately how many thatches would you need to cover one side of the building?

[Answer: (6 x 2 = 12) thatches for one side and approximately 24 thatches for both sides.]

Why?

[Answer: "Because I calculated the area and even if I did not mention the width of the thatches, it is understood that most thatches in Yap OI are about 1 foot width. The roof is approximate because the actual shape of the side of the house is not a square."]

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