

Bentwood Box

Extension Lesson

Grade Levels: 6 – 8

NOTE: This is a revised version of the original Bentwood Box unit, which was written for fifth grade students. The original unit consisted of eight lessons, with more emphasis on learning to compute area and volume. For middle school students, the basic computations are excellent examples of applied mathematics involving a 3-dimensional object. The unit also teaches linguistic, cultural and traditional woodworking skills.



Unit Overview

The bentwood box is unique to the Northwest coast of North America. No other people in the world devised a wooden container made by steam bending a single plank to form all four sides. Using this technique, Tlingit artisans succeeded in creating utilitarian and visually impressive wooden containers that were used for a wide variety of purposes. They are used to store everything from the most prized possessions including precious artifacts to winter food stores. When a family made a long journey, they would store their most valuable possession in a bentwood box. Fresh water for the journey would be stored in another bentwood box with an air tight container to prevent spillage.

Many bentwood boxes were decorated with painted designs. Larger boxes may have a carved and painted front side. Among the Tlingit, the bentwood box became a valuable trade item itself. Bentwood boxes were produced for utilitarian purposes. Undecorated boxes were used as water containers and also for cooking. Heated stones were placed in the box to bring water to a boil for cooking food. The precision of the artist making the box is evident, especially when the box is made so well that they can hold water and be used for cooking. The Tlingit artisan used precise measurements in order for boxes to be bent and fit together exactly.

In this unit we use the bentwood box to study measurement. Students will learn to measure length and width, calculate the area of a rectangle, calculate the volume of a cube and recognize the relationship between the perimeter of the base and the length of a plank needed to fit around and form the sides of a box.

Lesson Overview

In the Pre-Assessment

Students are asked to describe what bentwood boxes are used for, what they are made of, how they are made and how much they can hold. The teacher is looking for use of vocabulary words and an understanding of Volume.

In Lesson 1 (The Bentwood Box) The bentwood box is formally introduced. The basic structure of the box, the plank and base, is presented and students think about what characteristics make containers useful. Tlingit vocabulary is used to enrich this lesson.

In Lesson 2 (Determining the Volume) Students look at the base of a box and figure out the area using length and width. Once the area of the base is figured out, students can measure the height of the box to find the volume. Paper model boxes are made with different volumes to address this concept.

In Lesson 3 (Making a Plank and Base) Lesson three focuses on expanding student's math concepts of measurement and the inter-relationships between both parts of the box. The perimeter of the base is equal to the length of the plank, students are asked to create various boxes with a given volume but different dimensions.

In Lesson 4 (Model Bentwood Box) Boxes from the Burke museum are revisited in this lesson as students recreate the real boxes as paper models. Students often do not realize the real life scale of the old large storage boxes; this lesson puts it all in perspective. The topic of standard units, inch and centimeter and the decimal point in measurement is also crucial to student success in the recreation.

In Lesson 5 (Kerf and Bending) Up until now students have only bent paper. The task of bending a plank with thickness is explored in lesson seven. Problem solving with tools to remove thickness is done with foam core to simulate kerfing a wood plank.

In Lesson 6 (Traditional Boxes) Lesson eight will be best taught with the help of elders and carvers. Students look at images of the process of making a real bentwood box. With the support, the box can be used to cook and have a family dinner.

**Alaska State Standards,
National Science Education Standards and Targeted Skills**

English/Language Arts

A student should be a competent and thoughtful reader, listener and viewer of literature, technical materials and a variety of other information.

B.1) comprehend meaning from written text and oral and visual information by applying a variety of reading, listening and viewing strategies; these strategies include phonic, context and vocabulary cues in reading, critical viewing and active listening

Math

A: A student should understand mathematical facts, concepts, principles and theories.

A student who meets the content standard should,

- 1) understand and use numeration, including
 - a. numbers, number systems, counting numbers, whole numbers, integers, fractions, decimals and percent's; and
 - b. irrationals and complex numbers;
- 2) select and use appropriate systems, units and tools of measurement, including estimation;
- 3) perform basic arithmetic functions, make reasoned estimates and select and use appropriate methods or tools for computation or estimation including mental arithmetic, paper and pencil, a calculator and a computer;
- 5) construct, draw, measure, transform, compare, visualize, classify and analyze the relationships among geometric figures;

B: A student should understand and be able to select and use a variety of problem-solving strategies.

A student who meets the content standard should,

1. use computational methods and appropriate technology as problem-solving tools;
2. use problem solving to investigate and understand mathematical content;
3. formulate mathematical problems that arise from everyday situations;
4. develop and apply strategies to solve a variety of problems;
5. check the results against mathematical rules;
6. use common sense to help interpret results;
7. apply what was learned to new situations; and
8. use mathematics with confidence.

C: A student should understand and be able to form and use appropriate methods to define and explain mathematical relationships.

A student who meets the content standard should,

- 1) express and represent mathematical ideas using oral and written presentations, physical materials, pictures, graphs, charts and algebraic expressions;
- 2) relate mathematical terms to everyday language;
- 3) develop, test and defend mathematical hypotheses; and
- 4) clarify mathematical ideas through discussion with others

Cultural Significance

Bentwood boxes have long been used to hold our most precious items from winter food stores to at.óow that is passed down from generation to generation. These boxes are made in a wide variety of sizes to accommodate their multiple uses. Boxes could be utilitarian with minimal design work or be intricately carved with complex form-line work. The making of a bentwood box requires true artistic skill and continues to be an admired art form.

Elder/Culture Bearer Role

Elders provide the necessary link between the culture and the classroom. Elders can share personal experiences of “putting up” food for the winter and the traditional ways of storing food. Making this way of life real for students is key in this unit.

A carver who makes bentwood boxes could be invited to come share their work and talk or demonstrate the making of a bentwood box.

Family/Home/Community Connections

- **Home Connections**

Families can be invited to share stories about gathering food and storing it for the winter, to share bentwood boxes or baskets that they have at home and attend a family cook out.

- **Culminating Event**

There are two possible culminating events; they will depend upon the culture bearers that are available. The first is to make a bentwood box or watch one being made. If a connection with a

carver is made this event could be possible. The second is cooking in a cooking box. The idea place for this would be at a beach but anywhere you could make a fire to heat up cooking rocks safely would work. Again, this event will depend on the resources in both people and materials.

Unit Assessment

Pre-Assessment

Students are asked to describe what bentwood boxes are used for, what they are made of, how they are made and how much they can hold. The teacher is looking for use of vocabulary words and an understanding of Volume.

Post-Assessment

Students are asked to describe the uses, importance and characteristics of the Bentwood box. They also build a box the will hold a given amount and show their work using equations that describe length, width, height, area and volume.

Unit Vocabulary

- Area
- Centimeter
- Cube
- Cubic
- Dimension
- Edge
- Equation
- Face
- Height
- Inch
- Kerf
- Length
- Perimeter
- Petrel
- Plank
- Prediction
- Unit
- Volume
- Width

Tlingit Vocabulary

- Kakt – Bentwood box
- Yá – Side (face of a cube)
- K'í – Base (a standing object)
- Aadé ksixát – Join (it's connected there)
- Numbers (1 through 10)
- Shaawahík – Full
- A xákwti – Empty
- Kées – Bracelet
- Kat'ákxi – Seaweed
- Kooxéedaa – Pencil
- Kaashaxáshaa – Scissors
- Akaawataan – Bend
- Kerf – Ch'á yei googéink áwé yoo duwaxashk'
- Xaash aawaxaash – Cut
- X'úkjaa – Steam
- Kaa aawkáa – Sew
- Dleey – Meat
- Útlxi – Boiled Fish

Teacher Preparation for this Unit

Prior to the Pre-Assessment

- Gather a variety of baskets and bentwood boxes for students to study or set up a field trip to a museum.

Prior to lesson 1

- Print the images of containers and prepare to project with an overhead, document reader of projector.

- Pre-read the Raven and Petrel story.
- Print the Tlingit Language cards and practice speaking them or ask an elder to join your class to help with pronunciation.
- Print and copy the graphic organizer for the story.
- Print and copy the Student Evaluation sheet.

LESSON PLANS

Pre-Assessment

Bring in a variety of bentwood boxes and baskets for students to look at. Or take a trip to the museum to view boxes and baskets.

Ask: What do you think these are used for? What do you think these are made of? How do you think they are made? How much do you think they can hold?

Materials

- Pencils
- Chart paper
- Bentwood boxes if available
- Bean bag or other tossable object
- Teacher Resource: Containers (Images)
- Teacher Resource: Tlingit Language Image cards
- Teacher Resource: Discussion Questions

Student Pages

- Graphic Organizer
- Homework

English Vocabulary

- Petrel

Tlingit Vocabulary

- Yéil – Raven
- Gaanook – Petrel
- Kakt – Bentwood box
- Héen – Water

Tlingit Language Session (30 minutes)

1. Post the language wall cards and have the class listen to the Tlingit words for each.

Lesson 1 – The Bentwood Box

Objectives

Students will,

- identify what Tlingit containers were used for and what characteristics the container needed to have.
- identify the plank and base used to make a bentwood box.

Time Needed

Session 1: Engage – Containers (30 minutes)

Session 2: Explore, Explain and Elaborate – A Closer look at Bentwood boxes (45 minutes)

Session 3: Evaluate (20 minutes)

Materials

- Chart paper
- Markers
- Paper (for student writing)
- Scissors
- Crayons
- Tape or Yarn
- Paper or Card Stock
- Bentwood box (if available)
- Teacher Resource: Sample Box Pattern
- Teacher Resource: Study Prints

Student Pages

- Student Box Pattern

English Vocabulary

- Plank
- Cube
- Edge
- Face

Tlingit Vocabulary

- Yá – Side
- K'í – Bottom/base of box
- Aadé ksixát – Join

Session 1: Engage – Containers (30 minutes)

1. Bring in several examples of modern containers. Show them and ask student what they are used for.
2. Each student then thinks of one container that is important in their life and answers the questions for it:
 - What is the container used for?
 - What characteristics must the container have?
 - What Tlingit container would serve a similar purpose?
3. Then, pose the question to the class: If you were living 200 years ago and needed to store your food for the winter, what would you use? If you needed to cook? If you needed to store your clothing?
4. Lead the discussion/brainstorm to include the use of local resources as materials for containers, such as trees. We can get roots and bark from trees to weave with and we can also use the wood to make boxes.
5. Use the posted image as prompts and ask the questions: What do you think these containers were used for? What are they made of? Make a chart on chart paper or the white board and record the answers. Use the student resource “Containers (Images)”.

What do we need containers for?	What container could we use?	What characteristic would the container need to have?	What Tlingit container would serve a similar purpose?
Cooking	Pots and pans	Water tight, heat resistant, strong	Cooking baskets and boxes
Noodle Strainer	Colander	Hold the larger objects in while letting water out	Clam baskets
Save food for later	Plastic containers with lid	Air tight, water tight	Bentwood boxes

Session 2: Explore, Explain and Elaborate – A Closer look at Bentwood boxes (45 minutes)

1. Show study prints of bentwood boxes and or a real bentwood box and ask the students how they think they were made. Notice that only one edge has a join, the other edges are all bent.

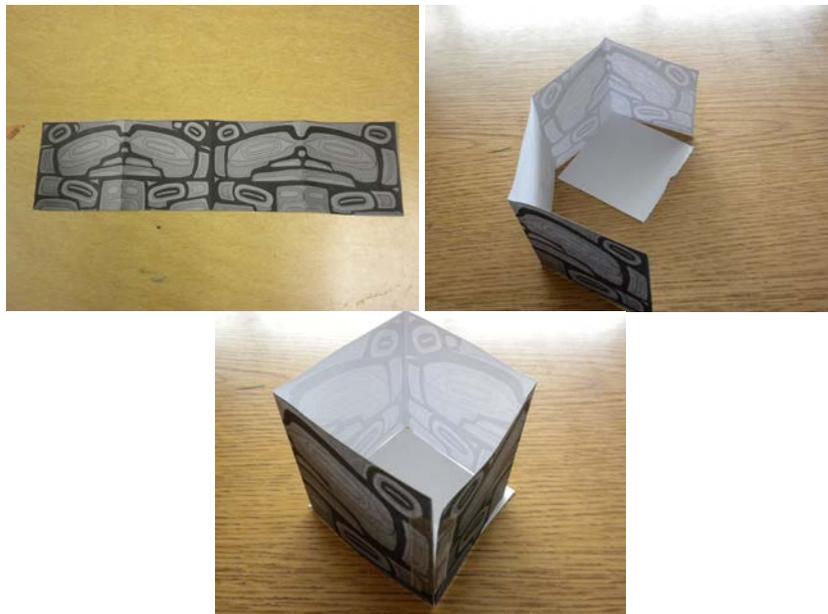


Bentwood Box

Bent Corner

Join Corner

2. How do they think wood can bend? Come up with ideas but save the real details for a later lesson. Let the students ponder if they don't get it right away.
3. Have the paper sample cut out and ready to show the plank and bottom of a box. Show the class how two pieces of wood were used to form the bottom of the box and the plank was bent to form the sides.



4. Look at posted images again and notice the one edge join.
5. Give the students the Student paper box pattern to cut and assemble. If using plain paper, tape the edges together. If using card stock, whole punch the joining edges and use yarn (to imitate spruce roots) to assemble.



Evaluation prompt: describe how to put a bentwood box together.

Session 3: Evaluate (20 minutes)

- What were Tlingit containers used for and what characteristics did the container need to have?

Rubric – Student

1	2	3	4	5
<ul style="list-style-type: none"> ●minimal answers or answers are off topic 	<ul style="list-style-type: none"> ●uses include one use ●characteristics include 0-1 ideas 	<ul style="list-style-type: none"> ●uses include 1-2 uses ●characteristics include 1-2 ideas 	<ul style="list-style-type: none"> ●uses include storage of food and water ●characteristics include strength, durability and use. 	<ul style="list-style-type: none"> ●uses include storage of food and water as well as another item such as clothing and tools. ●characteristics include strength, durability and a specific use such as clam basket lets out water or a cooking box is water tight.

Additional Optional Activities

- Use book: “The Bentwood Box – An Activity Book” by Nan McNutt

Lesson 2 – Determining the Volume of a Bentwood Box

Objectives

Students will,

- measure length and width to determine the area of a rectangle and represent that with the equation: $\text{Length} \times \text{Width} = \text{Area}$.
- use area of an unknown rectangle to determine possible lengths and widths.
- calculate volume of a box with the equation: $\text{Area} \times \text{Height} = \text{Volume}$.

Time Needed

Session 1: Engage and Explore – How many will fit? (45 minutes)

Session 2: Expand and Explain – How much do we have? (45 minutes)

Session 3: Elaborate (45 minutes)

Session 4: Evaluate (20 minutes)

Materials

- Box or rectangle shaped container
- Cubes of two sizes that will fit in the bottom such as base ten cubes: ones and linking cubes
- Several boxes for student use: tea or pencil boxes work well, anything with a rectangular shaped base
- Teacher Resource: Seaweed Cakes

Student Pages

- Student Prediction sheet
- Student Area sheet

English Vocabulary

- Unit
- Length
- Width
- Area
- Dimension
- Prediction
- Equation

Tlingit Vocabulary

- 1) tleix'
- 2) deix
- 3) nas'k

Goldbelt Heritage Foundation

US Department of Education PR/Award #: S356A090050: *Wooch.een: Together We Can*

- 4) daax'oon
- 5) keijin
- 6) tleidooshu'
- 7) daxadooshu'
- 8) nas'gadooshu'
- 9) gooshuk
- 10) jinkaata

Activities

Throughout the unit we will be using cubes to measure the dimensions of different boxes. The labeling of the unit size will depend on what size cube you use in your classroom to measure with. Through this unit we will label the measurement as “unit”.

Session 1: Engage and Explore – How many will fit? (45 minutes)

1. Have a review discussion about the uses of bentwood boxes. One of those being food storage. Show the image of the drying seaweed cakes.
2. Ask, why they think they were made into that shape? To fit into a bentwood box for storage.
3. Ask, what would you need to know before you made you seaweed cakes? The size of the box, the length and width of the box you were going to use to store your seaweed.
4. Show the class a box and ask them how many cubes they think it will take to cover the bottom of the box. Students should eventually ask how big the cubes are. Have a discussion about why the size of the cube matters; the larger the cube the less will fit and the smaller the cube the more will fit.
5. Show them the cube you will use, call it “cube A” and then ask them to guess again.
6. On chart paper, record their predictions.

	Prediction	Actual	Equation
Cube A			
Cube B			

7. Cover the bottom of the box with “cube A” and show the class.

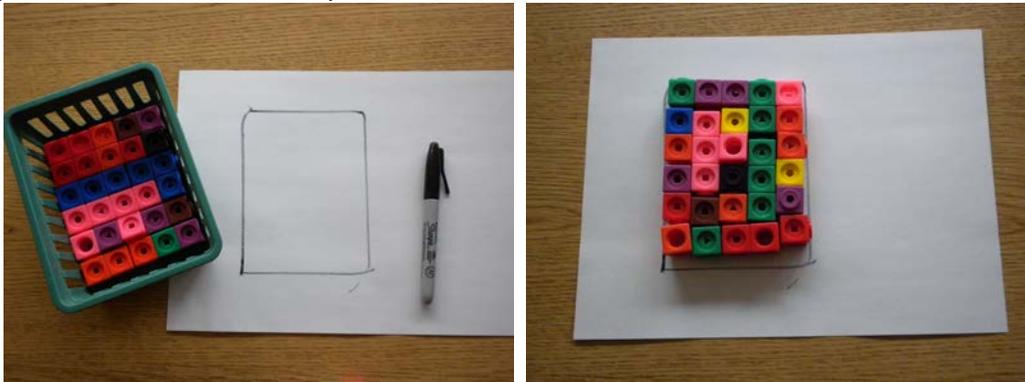


8. Ask how they counted and what ways would make it easier to count. Multiplying the blocks in one row by how many rows there are: length X width = Area
9. Record the actual amount and the equation on the chart.
10. Discuss the concept of “area” as the amount of 2-D space that is taken up in a shape or “area”.
11. What happens if we use a different size cube?



12. Cover the bottom of box with “cube B”: Record the predictions, actual and equation on the chart. Was it more or less and why?
13. Have each student use an empty box or rectangular shaped container to find the area of the bottom of the box using two sized cubes. Record the findings on the student prediction sheet.

Option: if you don't have enough boxes for all students to have one, trace the base of the box onto paper and fill the traced shape.



As a follow-up or for further practice students use grid paper, give them the length and width of a rectangle and have them find the area and show an equation to go with it. This activity can be used as a warm up in the future.

Session 2: Expand and Explain – How much do we have? (45 minutes)

1. Give each student 18 cubes. Ask them to put them together in rows to form the base of an imaginary box.
2. Ask students share how they arranged their cubes and record the equations that match their rectangles on chart paper: explain that when we are taking about dimensions of a rectangle, we read lengths “nine by two” or “three by six” etc...

Rectangle Area	Length x Width	Length x Width	Length x Width	Length x Width
18 cubes	9 x 2	3 x 6	6 x 3	2 x 9
24 cubes				



3. Repeat with a new amount of cubes, such as 24, record equations on the chart.
4. Give each student 24 cubes and to put them together in layers to form a box.
5. Ask students share how they arranged their cubes and record the equations that match their boxes on chart paper:

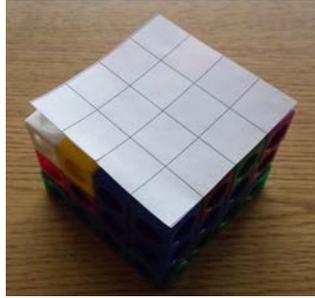
Box Volume	area x height	area x height	area x height	area x height
24 cubic in.	6 x 4	4 x 6	12 x 2	8 x 3
32 cubic in.				

1. Repeat with a new amount of cubes, such as 32, record equations on the chart.
2. As students work ask them to tell you the various dimensions of the boxes they build. What is the height of your box? What is the width? What is the length?
3. Hold up a sample box built with cubes, choose on that has different lengths for height, width and length. Do they change if you move the position of the box?

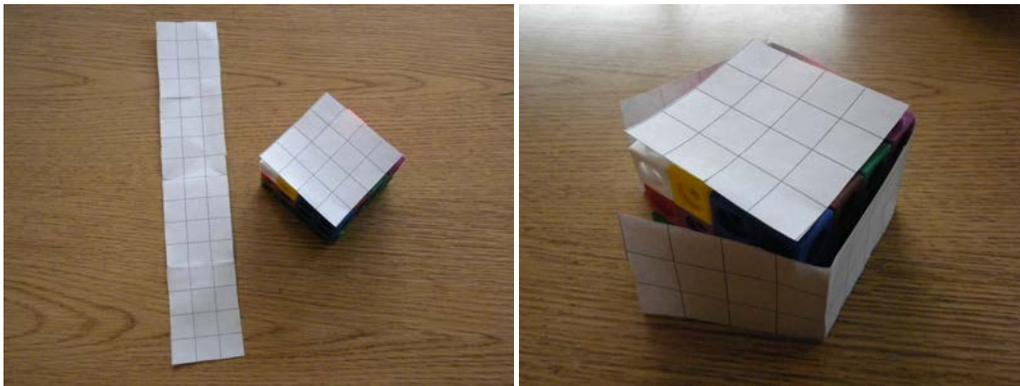
Define: When we are talking about how much a container can hold, we call that “volume”. When measuring volume we use the term “cubic” to describe the cube shape that we are measuring with, it is the “unit”. We then need to label the cube size. Is it an inch or centimeter?

Session 3: Elaborate – Building a Box with Paper (45 minutes)

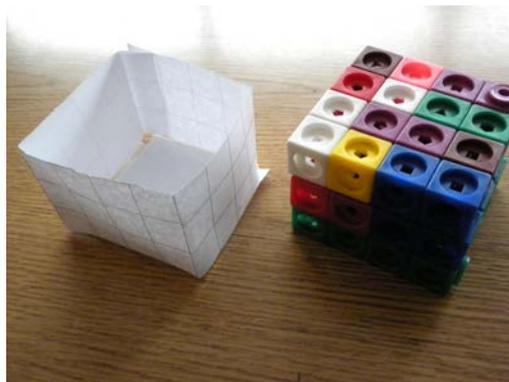
1. Have students build a box out of cubes with a given volume, height, width and length. Example: $V=48$, $H=3$, $W=4$, $L=4$
2. Give the class grid paper with equal size grid squares as the cube they are using. to make a base for the box they have built with cubes. They should make a 4 x 4 square that covers the bottom of the cubes.



3. Next, ask them to make a “plank” that will wrap around the cubes and make the sides of the box. Let the students struggle and try several times if they need to before having a discussion on strategies.



4. Ask the class to describe ways they figured out how to get the right size paper to wrap around the cubes.
5. Model for the class that if you measure each side length (perimeter), add them all together, you will have the length of the plank.
6. Remove the cubes and tape the paper box together.



Session 4: Evaluate (20 minutes)

1. Use the student worksheet [Evaluation Worksheet](#).

Lesson 3 – Making a Plank and Base

Objectives

Students will,

- recognized the relationship between the plank length and the perimeter of the base.
- be able to create a base for a given plank length.
- be able to create various boxes for a given volume.

Time Needed

Session 1: Engage and Explore – Mystery Base (30 minutes)

Session 2: Explain and Elaborate – Make a Base (45 minutes)

Session 3: Evaluate (20 minutes)

Materials

- Scissors
- Tape
- Crayons

Student Pages

- Mystery Base
- Evaluation

English Vocabulary

- Perimeter

Session 1: Engage and Explore – Mystery Base (30 minutes)

1. Keeping in mind what we learned about the box in lesson 2, give students the Mystery Base worksheet. Predict what bottom will fit the plank. Color and cut out the predicted bottom.
2. Cut out the plank and try putting the box together. If it doesn't fit, continue trying until the correct base is found. Students may struggle with finding the fold lines to fit the base. Encourage those who figure it out to share their strategies. Each side length of the base will match with a length on the plank.
3. What do we notice about how the length of the plank is related to the base? Students may struggle with this at first. Give them time to talk and try different strategies. Some students may want to cut out the base's and "roll" them along the length of the plank.
4. Once students have had time to work with this, show them that the length of the plank will be the same as the **perimeter** of the base.
5. Define perimeter as the distance around an object.

$$\text{Length of plank} = \text{perimeter of base}$$

Session 2: Explain and Elaborate – Make a Base (45 minutes)

1. Give all students a sheet of grid paper. Working together as a class, make a plank that is 8 units high and 50 units wide. Cut it out.
2. Discuss some strategies for making a base for this box. Folding it first to find the lengths of the sides, counting and dividing by 4, which will not come out even so then what? Etc.
3. Show them one possible base: length is 15 and width is 10. We know this because $15+15=30$ and $10+10=20$, therefore $30+20=50$.
4. On chart paper show the equation:

$$(2 \times L) + (2 \times W) = P$$

length times 2 PLUS width times 2 EQUALS the perimeter

Teaching about the use of parenthesis in math may need to be pre-taught and/or practiced independently depending on the level of the class.

5. Advanced students may want to try other bases. Record the different dimensions on chart paper.

Possible base dimensions for a plank length of 50 units	
<u>Length</u>	<u>Width</u>
15	10
20	5

As a follow-up or for further practice students use grid paper, give them various dimensions for planks and have them find various base dimensions. Have them “prove” their work using equations.

Session 3: Evaluate (20 minutes)

1. Students match a plank to a base based on the length of the plank and the perimeter of the base. Use Student Evaluation sheet.

Lesson 4 – Model Bentwood Box

Objectives

Students will,

- use dimensions of a real box to build a model paper box.

Time Needed

Session 1: Engage and Explain – Building from Dimensions (45 minutes)

Session 2: Explore, Elaborate, Evaluate – Build a Model of a Bentwood Box (60 minutes)

Session 3: Tlingit Language – In the Box, Out of the Box (30 minutes)

Session 4: Evaluate (20 minutes)

Materials

- Internet access for students OR
- Preprinted images of bentwood boxes with their dimensions
- Large Paper (butcher paper on rolls)
- Tape
- Scissors
- Measuring Tape or Yard Sticks (with both inches and centimeters)
- Teacher Resource: Bentwood Box with Dimensions
- Teacher Resource: Tlingit Language Image Cards

Student Pages

- Tlingit Language Practice Sheet

English Vocabulary

- Inch
- Centimeter

Tlingit Vocabulary

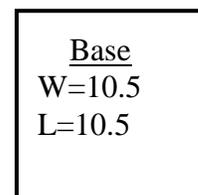
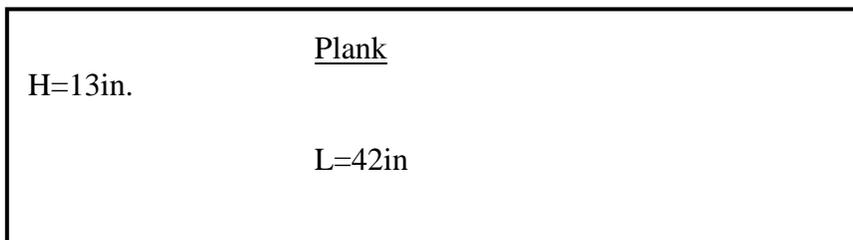
- Kées – Bracelet
- Kat'aḵi – Seaweed
- Kooxéedaa – Pencil
- Kaashaxáshaa – Scissors

Activities

Session 1: Engage and Explain – Building from Dimensions (45 minutes)

Prior to this activity, prepare the bentwood box image for projection for the class to view. Many of the measurements given will be in either inches or centimeters and also may use a decimal point. A prior lesson maybe needed on using these measurements if the class is not familiar with these concepts.

1. Show the bentwood box with the dimensions (worksheet)
2. Ask the class a series of questions about the dimensions: How wide is the box? How long is the box? What is the area of the base of the box? How tall is the box? What is the volume of the box?
3. Using blank unlined paper, have the class **sketch** the plank and base of the box. Label both with the dimensions:



4. Hand out large paper and model building the box according to the dimensions with the class following along. Ask the class for directions as you build.
Be sure to include in the modeling: showing the class strategies for measuring and making square corners when drawing rectangles.

Session 2: Explore and Elaborate (45 minutes)

Students can work in teams of two or individually depending on computer/internet access. If neither is available, pre-print box images with dimensions.

1. Students search an internet museum site for bentwood box images that have dimensions. The Burke Museum is a good place. They have 3 sections in the Ethnology section on bentwood boxes, chests and bowls.
<http://www.washington.edu/burkemuseum/collections/ethnology/collections/>
2. In teams of two or individually students:
 - a. select and print an image
 - b. sketch the plank and base with dimensions to use as a plan
 - c. draw, cut and assemble paper to make a model box to actual size

Session 3: Tlingit Language – In the Box, Out of the Box (30 minutes)

Use actual objects listed in this activity if possible. If not use the worksheet provided with the image enlarged. The worksheet can also be used later as a follow up and for more practice.

1. Students gather in a circle, place a bentwood box in the center along with some other objects that can be placed in the box such as a bag of seaweed, a bracelet, a pencil, scissors, a shirt. Any objects could be used as long as the Tlingit vocabulary is known.
2. Use the Vocabulary cards to practice the object words. Point to the word, say the word, students repeat the word.
3. Ask one student to, "Put the _____ in the box." in Tlingit. Use a gesture to show that you are asking the student to put something in the box. Let them listen for the object word.
4. Repeat with a new student until all the objects are in the box.
5. Ask one student to, "Take the _____ out of the box." in Tlingit.
6. Repeat with new students until all the objects are out of the box.
7. Continue until all students have had at least one turn.
8. Practice again later with the Tlingit Language Practice sheet. Each student cuts out the image cards and places the picture on the box picture to show that they are putting the object in the box and taking it out.

Session 4: Evaluate

1. Completion of the Activity in Session 2 is a good assessment of student's conceptual understanding. Ask each student to write about how they build the model paper box in Session 2.
2. Can students independently:
 - use the dimensions of a given box to calculate the dimensions of the plank and base?
 - calculate the volume?
 - assemble a model box?

- describe their thinking and use equations to show their work?

Lesson 5 – Kerfing and Bending

Objectives

Students will,

- understand that in order to bend a plank with thickness, some of the thickness needs to be removed for the plank to bend.
- understand that the kerfed area takes up length and needs to be calculated in the measurements of the box.

Time Needed

Session 1: Engage and Explore – Bending (45 minutes)

Session 2: Explain and Elaborate – Foam Core Box (45 minutes)

Session 3: Evaluate (20 minutes)

Materials

- Foam Core (enough for pairs of students to create a box)
- Sharp Blade (for cutting foam core)

English Vocabulary

- kerf

Tlingit Vocabulary

- Akaawataan – bend

Prior to these activities strips of foam core need to be cut to size using an Exacto knife or box cutter.

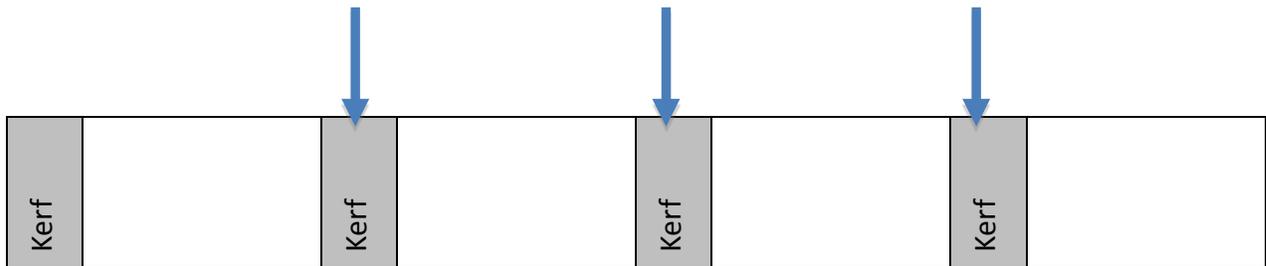
Session 1: Engage and Explore – Bending (45 minutes)

1. Now that we have made several paper model bentwood boxes, what would we need to do to make a real box out of wood? What problems would we encounter and what tools would we need? Make a chart.
2. Ask the class what would be difference there would be compared to folding a piece of paper. The thickness and strength of the wood plank would make it hard to bend.
3. Hold up a piece of foam core in the shape of a plank and have a student come and try to bend it. What about the foam core makes it hard to bend? The thickness of it. Ask the class if they have ever tried to fold several pieces of paper at the same time. What do they notice? That the more paper they try to fold, the harder it gets.
4. So what do we need to do to bend the foam core? Remove some of the thickness where we want to bend it.
5. Give groups of 4 student’s one strip of foam core about 18 inches in length and at least 4 inches wide.

6. Brainstorm a list of possible tools found in the classroom that could be used to remove some of the thickness of the foam core. Pencils, scissors, forks, pens
7. Each student in the group draws a line where they would make a fold and chooses a tool to try and remove some of the thickness along the fold.
8. As a group the students decide on a tool that they think works best for removing the thickness along a line in foam core and share their ideas with the class.
9. Once each group has decided and shared they are ready to try to make a Foam Core Box.

Session 2: Explain and Elaborate – Foam Core Box (45 minutes)

1. Using the foam core strips from the previous session, students measure the width of the kerfed section. This will now have to be calculated into the measurements of the folds on the plank.
2. Using precut planks and bases made of foam core, students calculate the measurements to make folds in the foam core plank. Divide the plank into 4 sections (this requires 3 lines) and add the kerfed section to the measurements.



3. Use the selected tool to make the kerf and fold to make a bent plank for a box.
4. Use tape to connect the edges and the base to the box.
5. Measure the length and width, make a base and attach with tape.



Session 3: Evaluate

Writing prompt: Describe the challenge of bending a thick foam core.

What can be done to make something thick easier to bend? (kerfing) Why does it work?

Lesson 6 – Traditional Boxes

Objectives

Students will,

- understand the effect of heat and water on wood
- understand the traditional use of cooking boxes

Time Needed

Session 1: Engage, Explore and Explain – Traditional Bentwood Box (30 minutes)

Optional,

Session 2: Elaborate – Making a Bentwood Box with a Carver

Session 3: Elaborate – Cooking in a Bentwood Box: Family Field Trip

Materials

- 2 Sponges
- Cooking Box
- Cooking Rocks
- Tongs
- Meat (to cook)

Student Pages

- Make a Bentwood Box

English Vocabulary

- Kerf

Tlingit Vocabulary

- Cut – Xaash aawaxaash
- Kerf – Ch’á yei googéink áwé yoo
- X’úkjaa – Steam
- Akaawataan – Bend
- Kaa aawkáa – Sew
- Kleey – Meat
- Útlxi – Boiled Fish
- T’á.a – Plank
- Xáay tooyei xwa.oo – Steamed

Tlingit Phrases

- Kadulk’waat’ wé t’áa – Plank is bent.

These activities would be greatly supplemented by a carver who has experience with making bentwood boxes.

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Activities 2 and 3 are possible options if the culture bearers and carvers are available.

Session 1: Engage, Explore and Explain – Traditional Bentwood Box (30 minutes)

1. Now that we know that thick pieces of wood needs to be kerfed in order to bend, what needs to be done to make the wood bendable? Ask the class for ideas. What ways can we make solid objects softer? Spaghetti is soaked and heated, etc.
2. Wood is a porous material. It is filled with air spaces. It has the ability to absorb water and this makes it “softer” similar to a sponge. When a sponge is dry it becomes hard and shrinks. A water logged sponge expands and softens. (Show a wet sponge and a dry sponge.)
3. Ask the class if they have ever been on the beach and found a piece of water logged wood. How did it feel? (Heavy) Have they every found a dry piece of wood? How did it feel? (Light)
4. Hand out the “Making a Bentwood Box” sheet and read through it with the class.
5. Discuss the images and process.

Optional Sessions

Session 2: Elaborate – Making a Bentwood Box

1. Invite a carver to demonstrate the bending process.
2. Take photos as the demonstration takes place. Students should notice that the wood is not soaked but instead the water is applied to the wood in the form of steam. The heat and the steam change the state of the wood so that it is bendable.
3. Print the photos on paper for the student to write about after the demonstration.

Session 3: Elaborate – Cooking in a Bentwood Box Family Field Trip

1. Invite a culture bearer on a field trip to a beach to cook in a bentwood box.
2. Fill the box with water, the water makes the wood swell making it water tight.
3. Build a fire on the beach, place clean cooking rocks in the fire. The heat from the fire is absorbed by the rock.
4. Use tongs to remove the rocks and place in the box filled with water. The heat from the rocks is transferred to the water. As the water heats, the rock cools.
5. Place meat or fish in the water
6. Remove the cool rocks and replace with hot rocks from the fire
7. Continue until meat is cooked
8. Remove the meat and enjoy!

Final Assessment

Describe the importance of the bentwood box to Tlingit people.

Build a paper box with a volume of 40 cubic units; show your work using equations and labels.

Included in the [Make a Bentwood Box](#) worksheet included in resources.