

Bentwood Box Math

Grade Levels: 4-5

Unit Overview

Tlingit bentwood boxes have long been an integral part of life in the Northwest coast. They are used to store everything from the most prized possessions including precious At.óow to winter food stores.

Precise measurements are needed in order for boxes to be bent and fit together exactly. 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 as a cooking box.



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 (Raven and Petrel) students are introduced to traditional Tlingit containers, their uses and the materials used to make them. The story of Raven and Petrel is told to set the stage for further discussion about the importance of containers. Tlingit vocabulary is used to enrich this lesson.

In Lesson 2 (The Bentwood Box) the bentwood box is formally introduced in lesson two. The basic structure of the box, the plank and base, is presented and students think about what characteristics make containers useful.

In Lesson 3 (Covering the Base) using bentwood boxes as food storage was an important part of Tlingit life. Seaweed cakes were made, dried and stored in layers in the bentwood box. Keeping this in mind, students look at the base of a box and figure out the area using length and width.

In Lesson 4 (Stacking in Layers) once the area of the base is figured out students can then measure the height of the box to find the volume. Knowing how much can fit in a box helps you know how much food to gather. Paper model boxes are made with different volumes to address this concept.

In Lesson 5 (Making a Plank and Base) 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 6 (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 7 (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 8 (Traditional Boxes) 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. Students also will take home a sheet to talk about what containers they have at home and how they are used.

Culminating Event

There are two possible culminating events; they will depend upon the culture bears 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
- Plank
- Prediction
- Unit
- Volume
- Width

Tlingit Vocabulary

Tools – Jishagóon

Lumber	Kax'ás'ti
Build It	Layéx
Board	T'áa
Red Cedar	Laax
Stick Plug	A x'adéex'i
Pattern / Template	A kaayí
Axe	Shanaxwáayi
File	X'adaa
Chopper	Kas'uwaa
Drill	Tuláa

Measuring Stick	Kaay
Adze	Xút'aa
Planer	T'áa kayexaa
Curved Knife	Yoo katán litaa
Straight Knife	T'aa shuxáshaa
Rip Saw	Kax'ás'aa
Saw	Xáshaa
Square	T'eesh kaay
Whetstone	Yayeinaa
Petrel	Ganóok
Bentwood Box	Lákt
Inch	Koot'áax'aa
Yard	Kaas'
Foot	Kaa x'oos
Length	Kliyáat'
A Measure of It	A kaayí
End of It	A shú
Width	Koo woox'
A Top of the Edge of It	A wanka
Face	A yá
Edge of It	A wán
Corner	Gúksh, Gukshú
Pen / Pencil	Kooxéedaa
Eraser	Kaxíl'aa
In It / Inside of It / Inside an Open Container	A yík
In a River	Héen yík
Inside a Closed Container	A tú
It's Empty	Xákwti
S/he Bent It	Akaawataan
Water	Héen
Side (Face of Cube)	Yá

Base	K'í
Join	Aadé ksixát
Count Them	Wóoch kaanáx natóow
Fill It	Shalatlít'
Add the Numbers	Wóoch t'éit katúw
Full	Shaawahík
Empty	A xákwti
Bracelet	Kées
Seaweed	Kat'ákxi
Scissors	Kaashaxáshaa
Bend	Akaawataan
Boiled Fish	Útlxi
Kerf	Ch'á yei googéink áwé yoo duwaxashk'
A Meal	Atxá
Pilot Bread	Gáatl
Black Seaweed	Laak'ásk
Strawberry	Shakw
Cut	Xaash aawaxaash
Stream	X'úk jaa
Meat	Dleey
Smoke Hole	Gaan ká
Soak It	Akawlikél
It's a Lid	Yanaa.áat'ani

Lesson Plans

Pre-Assessment

Bring in a variety of bentwood boxes and baskets for student 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?

Lesson 1

Raven and Petrel

Objectives

Students will,

- identify two types of containers Tlingit people used and what were they made of.
- use a graphic organizer to summarize a story with 2 characters.

Suggested Time

3-4 Class Sessions

Materials

- ✂ Pencils
- ✂ Chart paper
- ✂ Bentwood boxes if available
- ✂ Bean bag or other toss able object
- ✂ Teacher Resource: Raven and Petrel story (on Goldbelt Heritage website)

Student Pages

- Graphic organizer
- Discussion Questions
- Container Images
- Homework
- Tlingit Language Wall Cards

English Vocabulary

- Petrel

Tlingit Vocabulary

- Raven – Yéil
- Petrel – Gaanook
- Bentwood Box – Lákt
- Water – Héen
- Smoke hole – Gaan ká

Tlingit Phrases

- Give me some water – Héen áx x'éit sa.ín

Session 1: Engage and Explore – Using our Resources (45 minutes)

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?

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.

1. Show images of containers made from local resources. Use the information provided on the images to discuss possible ways the containers were made; weaving, carving, etc.
2. Choose one image to use as an example, ask the class:
 - a. What is this container made of? **Spruce roots**
 - b. What do you think this container was used for? **Berry picking**
 - c. What makes you think that? **It has places to tie it around your neck**
3. Write the three questions on chart paper for the whole class to see.
4. Partner students up and give each group an image of a Tlingit container. Each group will prepare answers the 3 questions.
5. After a sufficient amount of time, each group shares their ideas with the class
6. Post the images in the classroom.



(Get the larger versions in the teacher resources document)

Session 2: Elaborate and Explain-“Raven and Petrel” (60 minutes)

1. Before reading: ask the class to listen for the container used in this story and to think about what is important about the container. Read the story
2. After reading: Post the discussion questions and ask the class what the important container was and why was it so important? What job did it have? What characteristics does it need to do this important job?
3. Possible responses: record responses on the chart
 - a. The important container was the bentwood box.
 - b. The container needs to hold water.
 - c. It is important because it was the only fresh water in the world.
 - d. It would need to be water tight, big, strong and durable
4. Tell the class that we are going to be learning more about the Bentwood Box.
5. Use the graphic organizer students answer questions (in the teacher resources document) about what Raven and Petrel wanted, what they did, what problem they encountered, what they did because of the problem, how the story ended and how the bentwood box was important to each.

Tlingit Language Session (30 minutes)

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

2. Place the picture cards on the floor as the class stands around in a circle. Give 4 students an object such as a bean bag that can be tossed and will not roll away.
3. Say one of the Tlingit Language vocabulary words and the four students try to toss the bean bag on the image of the word.
4. Give the bean bags to four new students and say a new word.
5. Continue until everyone has had at least one turn.

Session 3: Evaluate (20 minutes)

Journal entry:

- What types of containers did Tlingit people use and what were they made of?

Rubric- student includes:

1	2	3	4	5
-minimal answers or answers are off topic	-includes either baskets or boxes -resources include "trees"	-includes either baskets or boxes -resources include a part of a tree	-both baskets and boxes -resources from trees including bark, roots and the wood itself	-both baskets and boxes as well as one more idea for a container such as a bag or sack -resources from trees including bark, roots and the wood itself as well as another material such as leather.

Additional Possible Activities

- Continue a literature study on "trickster" characters in Native American oral history.

Lesson 2

The Bentwood Box

Objectives

Students will,

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

Suggested Time

4 Class Sessions

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

- Box Patterns
- Sample Box Pattern
- Study Prints

English Vocabulary

- Plank
- Cube
- Edge
- Face

Tlingit Vocabulary

- Side – Yá
- Bottom/base of box – K'í
- Join – Aadé ksixát
- Top edge – Wan ká
- Edge of it – A wán
- A measure of it – A kaayi

Session 1: Engage - Containers (30 minutes)

1. Ask the questions and make a chart on chart paper as follows: possible responses are given here as examples.
2. Use the posted images from Lesson 1 as prompts.

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

3. 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
4. Share with a partner.

Session 2: Explore and Explain - A Closer look at Bentwood boxes (30 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

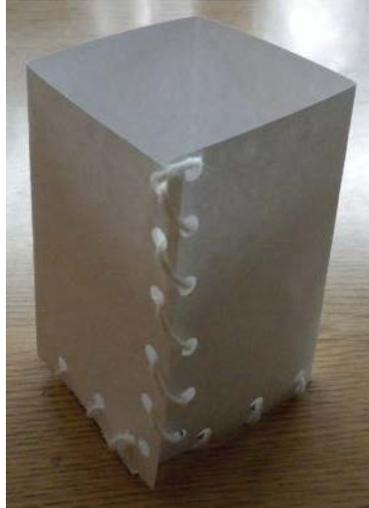
2. How do they think wood can bend? Come up with ideas but save the real details for a later lesson. Let the students ponder if they don't get it right away.
3. Have the paper sample cut out and ready to show the plank and bottom of a box. Show the class how two pieces of wood were used to form the bottom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



4. Look at posted images again and notice the one edge join.

Session 3: Elaborate - Sample Paper Bentwood Box (30-45 minutes)

1. 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.



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

Session 4: Evaluate (20 minutes)

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

Rubric- Student Includes:

1	2	3	4	5
-minimal answers or answers are off topic	-uses include one use -characteristics include 0-1 ideas	-uses include 1-2 uses -characteristics include 1-2 ideas	-uses include storage of food and water -characteristics include strength, durability, and use.	-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 3

Covering the Base

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.

Suggested Time

3 Class Sessions

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 layers photo

Student Pages

- Prediction sheet
- Area sheet
- Seaweed Cakes

English Vocabulary

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

Tlingit Vocabulary

- Count – Nayistóow/Nistóow

Tlingit Phrases

- How many are there? – X'oon sá dáx yatee?
- There are _____. – dahéen yatee.

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.

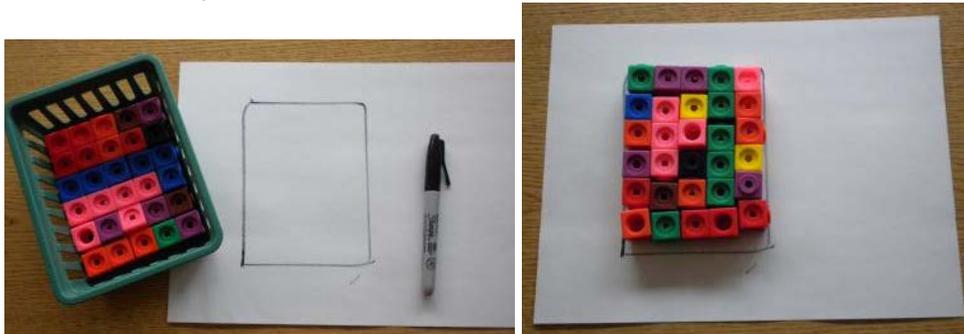


8. Ask how they counted and what ways would make it easier to count. Counting how many are in one row and multiply by how many rows there are: length X width = Area
9. Record the actual amount and the equation on the chart.
10. Discuss the concept of “area” as the amount of 2-D space that is taken up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



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 a class discussion about the importance of the size of the cube. The math term for this is the “unit” or what we are using to measure the length and width.
14. Each student then uses an empty box or rectangular shaped container to find the area of the bottom of the box using two sized cubes. Record their finding 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. Ask if there was only one way to solve the problem. Why is this?

Materials

- ✂ Linking cubes
- ✂ Grid paper
- ✂ Scissors
- ✂ Tape
- ✂ Chart paper
- ✂ Teacher Resource: Seaweed layers photo

Student Pages

- Evaluation worksheet

English Vocabulary

- Layer
- Height
- Volume
- Cubic inch/centimeter

Session 1: Engage – Fill the Box (60 minutes)

1. Re-examine the seaweed photo and review the concept of Area of the base of a box.
2. How would you know how many of these “cakes” could fit? You would need to know how many layers would fit. You would need to know how tall the box was. You would need to know the height.
3. 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?
4. If we look at a container that we found the area of the base for and we want to fill the whole box with cubes to find out how many cubes will fit in the box, what strategy can we use? Find out how many layers would fit.



Fill the box.



Remove the layers.



Count the layers.

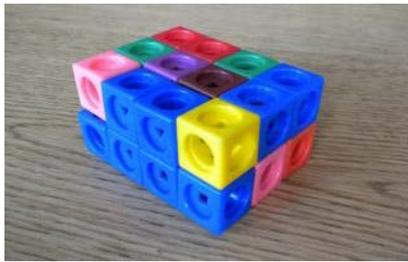
- If we know that each layer is 18 cubes and we have 4 layers, what equation can we use to find out how many cubes fit in the box? $18 \times 4 = 72$ cubes. OR $\text{Area} \times \text{Height}(\text{layers}) = \text{Volume}$

Session 2: Explore and Explain- How much do we have? (60 minutes)

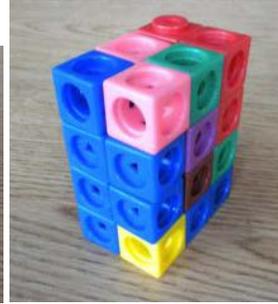
- Give each student 24 cubes and to put them together in layers to form a box.
- Ask students share how they arranged their cubes and record the equations that match their boxes on chart paper:

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

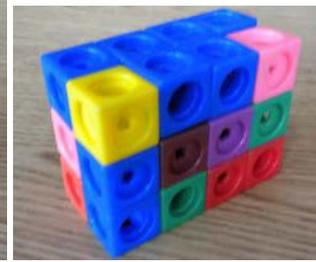
- Ask if there was only one way to solve the problem. Why is this?
- Repeat with a new amount of cubes, such a 32, record equations on the chart.
- As students work ask them to tell you the various dimensions of the boxes they build. What is the height of your box? What is the width? What is the length?
- 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?



$$12 \times 2 = 24$$



$$6 \times 4 = 24$$

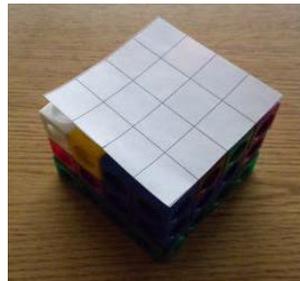


$$8 \times 3 = 24$$

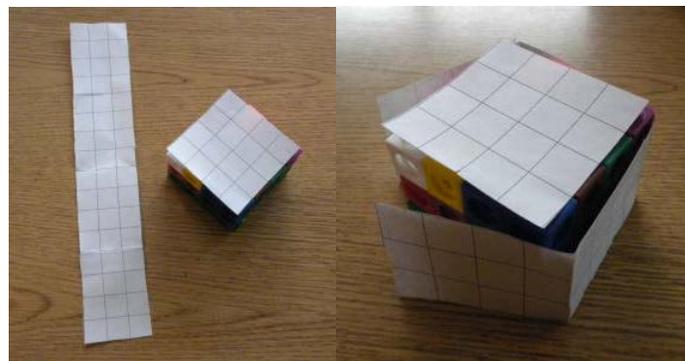
7. Note: it is important to know the starting position of the box before measuring and labeling. While these three cubes all have a volume of 24 they have different base areas and different heights.

Session 3: Elaborate- Building a Box with Paper (60 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.

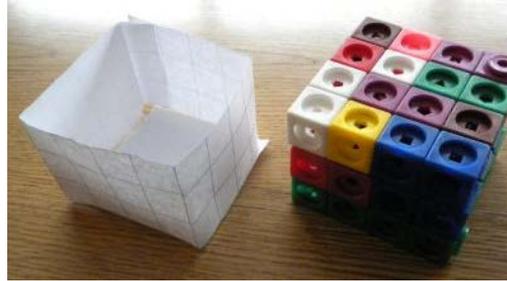


3. Next, ask them to make a “plank” that will wrap around the cubes and make the sides of the box. Let the students struggle and try several times if they need to before having a discussion on strategies.



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. Using given dimensions of a box, find the area of the base and the volume of the container. Use the given Evaluation worksheet.

Name _____

Estimated Box
Lesson 5
Evaluation worksheet

1. Label the box dimensions.
2. Find the area of the base of the box.
3. Find the volume of the box.
4. Show your work.

Length: 5 units
Width: 4 units
Height: 6 units



Lesson 5

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.

Suggested Time

3 Class Sessions

Materials

- ✂ Scissors
- ✂ Tape
- ✂ Crayons

Student Pages

- Mystery Base worksheet

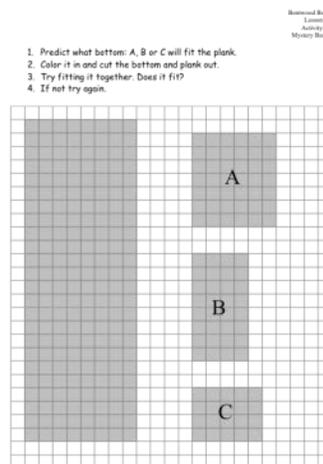
- Student Evaluation sheet

English Vocabulary

- Perimeter

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

1. Keeping in mind what we learned about the box in lesson 4, 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:

$$(2xL) + (2xW) = P$$

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.

- 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)

- Students match a plank to a base based on the length of the plank and the perimeter of the base.



Lesson 6
Model Bentwood Box

Objectives

Students will,

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

Suggested Time

3 Class Sessions

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 image with dimensions from the Burke Museum
<http://www.washington.edu/burkemuseum/collections/ethnology/collections/>
- ✂ Teacher Resource: Tlingit Language Vocabulary cards

Student Pages

- In the Box, Out of the box: Tlingit Language practice sheet

English Vocabulary

- Inch
- Centimeter

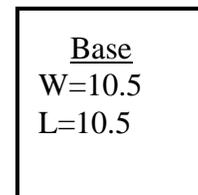
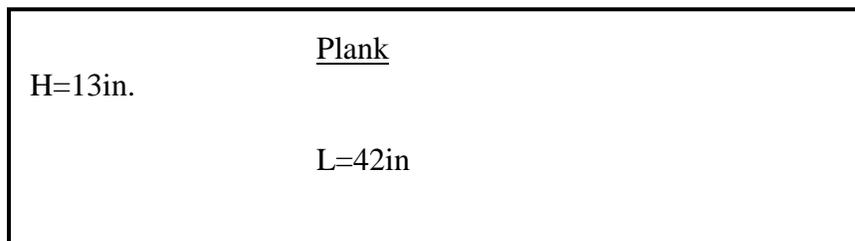
Tlingit Vocabulary

- Bracelet – Kées
- Pencil – Kooxéedaa
- Seaweed – Kat’aḱli
- Scissors – Kaashaxáshaa

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. (Student resources page)
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 (60 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



life size box

Tlingit Language Session: 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. Have 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 3: Evaluate

1. Completion of Activity 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.

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 7

Kerf 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.

Suggested Time

3 Class Sessions

Materials

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

English Vocabulary

- Kerf

Tlingit Vocabulary

- Bend – Akaawataan

Tlingit Phrases

- Bend it – Kanataan

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

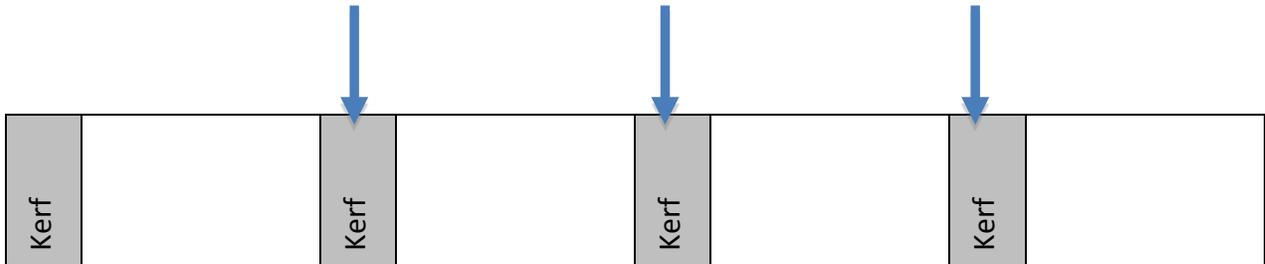
Session 1: Engage and Explore- Bending (45 minutes)

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, 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 (20 minutes)

Writing prompt: Describe the difference between bending a piece of paper vs. a piece of thick foam core. Which one is easier to do and why?

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

Lesson 8

Traditional Boxes

Objectives

Students will,

- Understand the effect of heat and water on wood
- Understand that heat is transferred from one object to another
- Understand the traditional use of cooking boxes

Suggested Time

3 Class Sessions

Materials

- ✂ 2 Sponges
- ✂ Cooking box
- ✂ Cooking rocks
- ✂ Tongs
- ✂ Meat to cook
- ✂ Teacher Resource: Traditional Box Making Posters

Student Pages

- Making a Bentwood Box Handout

English Vocabulary

- Kerf

Tlingit Vocabulary

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

Tlingit Phrases

- Plank is bent – Kadulk'waat' wé t'áa
- Let's eat! – Ax jeet kasatán wé ách at dusxa át!

Note: These activities would be greatly enhanced by a carver who has experience with making bentwood boxes. 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 its hard seems smaller, when it is water logged it expands and is soft. 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;
4. Place clean cooking rocks in the fire; the heat from the fire is absorbed by the rock.
5. Use tongs to remove the rocks and place in the box filled with water. The heat from the rocks is transferred to the water. We know this because the water heats and the rocks cool;
6. Place meat or fish in the water;
7. Remove the cool rocks and replace with hot rocks from the fire;
8. Continue until meat is cooked;
9. 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.