



Montana
Office of Public Instruction
Denise Juneau, State Superintendent

opi.mt.gov

Mathematics Model Teaching Unit

Surface Area and Volume of Traditional American Indian Homes

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Grade 8 – Approximate Duration: 100 minutes

Stage 1 Desired Results

Established Goals:

Geometric Reasoning Mathematics Content Standard 3: A student, applying reasoning and problem solving, will understand geometric properties, spatial relationships, and transformation of shapes, and will use spatial reasoning and geometric models to analyze mathematical situations within a variety of relevant cultural contexts, including those of Montana American Indians.

- **3.1 Properties of Solids and Figures:** Define, classify and compare properties of solids and plane figures, including lines and angles.

IEFA Essential Understanding 1: There is great diversity among the 12 tribal Nations of Montana in their languages, cultures, histories and governments. Each Nation has a distinct and unique cultural heritage that contributes to modern Montana.

IEFA Essential Understanding 2: There is great diversity among individual American Indians as identity is developed, defined and redefined by entities, organizations and people. A continuum of Indian identity, unique to each individual, ranges from assimilated to traditional. There is no generic American Indian.

Understandings:

Students will understand...

- that there are several different types of traditional American Indian houses.
- that traditional American Indian houses contain various plane and solid geometric figures.
- how to find surface area of various plane geometric figures.
- how to find volume of various solid geometric figures.

Essential Questions:

- What are some types of traditional American Indian houses?
- What plane and solid geometric shapes do some traditional American Indian houses contain?
- How do you calculate surface area and volume of traditional American Indian houses?
- How would knowing surface area and volume help a builder construct a building?

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Students will be able to...

- identify a variety of geometric plane and solid figures.
- calculate area of geometric plane figures and surface area and volume of geometric solids.

Students will know...

- how to find area of various geometric plane figures.
- how to find surface area and volume of various geometric solid figures.

Stage 2 Assessment Evidence

Performance Tasks:

- Build a structure out of wooden dowels and rubber bands.
- Compare geometric plane and solid shapes to traditional American Indian houses.
- Identify a variety of geometric plane and solid figures.

Other Evidence:

- Teacher observations of student participation during all portions of the lesson.
- Student presentations.
- Peer assessment and input during small-group activities.
- Question responses of individual students.
- Homework assignment (found later in the lesson).

Stage 3 Learning Plan

Learning Activities:

A. Open and “hook”:

1. Use cards chosen out of a standard deck to allow for random grouping upon entry into the classroom by the students. For groups of two, use 2 of each card number. For groups of 3, use 3 of each card number. For instance, all the Aces will be in a group, all the Kings will be in a group, etc.
2. As students enter the room, have them draw a card out of the deck. Ask them to find the other student(s) that have the same number on their card(s) and sit at a table or group of desks.
3. State the “Understandings” for the lesson.
4. Show the kids some dowels and a bag of rubber bands. Explain that each group will get 16 dowels and a bag of rubber bands. Inform the kids they are going to make a structure out of these materials that has to be tall enough for a 4-foot tall person to stand in it.
5. Issue the materials to each group, and inform them they have 10 minutes to complete their structures and all in the pair/group must participate.

B. Survey ideas for naming plane and solid figures:

1. Ask students to go around the classroom. Inform them they are to record the names of every plane and solid figure they can find on the dowel structures, and whose structure it belongs to, on paper. Give them 3 minutes to do this.
2. Record the information the students wrote down on the board in 2 columns, one for plane figures and one for solid figures (sample responses may include: rectangles, triangles, squares, pentagons for planes; various pyramids or prisms for solids).
3. Discuss as a class.
4. Distribute the Student Area and Volume Handout to each student.

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5. Ask the students to decide which of the shapes from the handout were created in their constructions. Have the students do this in a “Think, Pair, Share” format (think about it, share with the person they sat by, and be ready to share with the class).
6. Discuss as a class.

C. Familiarizing students with traditional American Indian housing:

1. Distribute a student handout, which you create, pertaining to different types of traditional American Indian housing, make overheads to display for the students, or project the webpage that can be found at <http://www.native-languages.org/houses.htm>.
2. Have each student decide which (if any) of the traditional American Indian housing their dowel structure resembles. Be sure to discuss the writings accompanying each house style.
3. Have each group present orally to the class the type of house they chose and explain why. If a group didn't come up with one, assign one that the other kids won't be utilizing. Each group should determine which geographic region of Native Americans most likely utilized this type of dwelling. In addition, groups should determine, which, if any, Montana tribal group(s) would have utilized this dwelling.

D. Calculate surface area and volume for the dowel houses chosen by each group:

1. In groups, have students sketch a picture of the traditional housing type that they chose. Tell them to use geometric plane and solid figures from the first student handout in their drawings. Have students complete all of the steps individually, utilizing their partner for assistance and comparisons.
2. Ask the students to label next to each shape that makes their house what it is (i.e.—circle, triangular prism, rectangle, cone, etc.)
3. Using the handout from part “C”, have the students label dimensions on their sketch to the nearest foot. The teacher may need to assist with estimations if actual dimensions are not provided.
4. Discuss how they could calculate how much material they might need to create a fully-covered house. Lead the discussion towards surface area.
5. Have the students calculate the surface area of their house, explaining their process and reasoning to their partner as they progress. One group member can be a “traveler” if the group is stuck to consult another group for assistance. Circulate about the room, and assist if needed.
6. Have the students share what they did to the class on the board. All group members must participate in the presentation.
7. Complete steps 4 through 7 above for the volume of their house.

E. Assign Surface Area and Volume of Traditional American Indian Homes

1. How would knowing surface area of a traditional home help the builder? How about builders of modern day homes? **Possible answer: to know approximately how much material would be needed to build.**
2. How would knowing volume of a traditional home help the builder? How about builders of modern day homes? **Possible answer: to know approximately how much space would there be inside.**
3. Find two different solid shapes in real life. Select items that can be found on our formula sheet.
4. Draw a picture of each and explain what the shapes represent.
5. Measure the dimensions, and label them on your picture.
6. Calculate the surface area and volume of the two shapes.
7. Be ready to present the results of your homework in class tomorrow.

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Materials/Resources Needed:

- A deck of standard playing cards.
- Enough wooden dowels and bags of rubber bands for each group. Each group will need sixteen 3-foot wooden dowels and a bag of rubber bands. If access or money is an issue, plastic straws could be substituted for wooden dowels, but lesson steps would have to be modified.
- Copies of the student handouts for each student (furnished at the end of the lesson). You may also choose to make overhead transparencies of the handouts for discussion purposes.

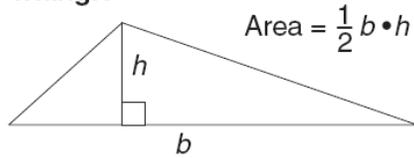
References:

- Montana Office of Public Instruction CRT Math Reference Sheet Grade 8
- <http://www.native-languages.org/houses.htm>

Name _____

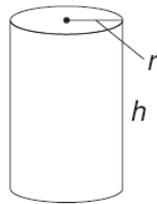
Student Area and Volume Handout

Triangle



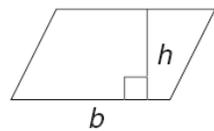
Area = $\frac{1}{2} b \cdot h$

Cylinder



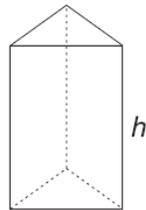
Volume = $\pi r^2 h$
Surface Area = $2\pi r^2 + 2\pi r h$

Parallelogram



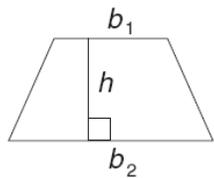
Area = bh

Prism



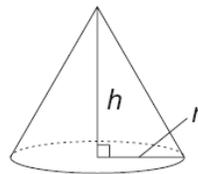
Volume = Bh
where B = area of base

Trapezoid



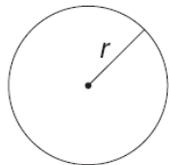
Area = $\frac{1}{2} h (b_1 + b_2)$

Cone



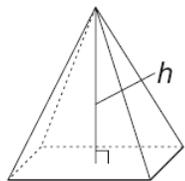
Volume = $\frac{1}{3} \pi r^2 h$

Circle



Area = πr^2
Circumference = $2\pi r$

Pyramid



Volume = $\frac{1}{3} Bh$
where B = area of base

Assignment for students:

Name _____

Surface Area and Volume of Traditional American Indian Homes

1. How would knowing surface area of a traditional home help the builder? How about builders of modern day homes?
2. How would knowing volume of a traditional home help the builder? How about builders of modern day homes?
3. Find two different solid shapes in real life. Be sure the items have shapes that can be found on our formula sheet.
4. Draw a picture of each and explain what the shapes represent.
5. Estimate or measure their dimensions, and label them on your picture.
6. Calculate the surface area and volume of the two shapes.

Be ready to present the results of your homework in class tomorrow in groups of 4.