Volume and Surface Area of Right Rectangular Prisms and

Summary

Students will compare three dimensional objects using attributes. Students will find surface area and volume of right rectangular prisms and of cylinders.

Main Core Tie

Mathematics Grade 6

Strand: GEOMETRY (6.G) Standard 6.G.2

Materials

Manipulatives: Geometry solids for each group, 100 Linking Cubes for each group, stack of quarters

- Transparencies for three-dimensional shape problems (optional)

Foldables: Three-Dimensional Words Tri-fold, Volume and Surface Area folder/ index cards

Worksheets: Linker Cube Volume and Surface Area Comparisons, Classifying Solids

Background for Teachers

Enduring Understanding (Big Ideas):
Attributes of geometric figures help us identify the figures and find their measures.
Essential Questions:

Where do we see examples of three-dimensional objects in the real world?
How are length, width, and height related in finding surface area and volume of a prism?
How can the surface area of a cylinder be determined?
How can formulas be used to find surface area?

Skill Focus:
Find examples of three dimensional objects in the world. Identify and classify three dimensional objects.
Vocabulary Focus:
Three-dimensional, face, edge, vertex, vertices, base, right rectangular prism, triangular prism, pyramid, sphere, cylinder, surface area, volume
Ways to Gain/Maintain Attention (Primacy):
Sorting, cooperative groups, manipulatives, games, music and movement, connection to real world, pictures

Instructional Procedures

Starter: Find the area for each
Lesson Segment 1: What attributes can be used to identify and classify three-dimensional objects?
Give teams of students a set of Geometric solids. Using the Classifying Solids worksheet as a guide, have student teams sort the three dimensional objects in the set. Have them write their information on the worksheet. As teams report on their classification rules, help them use the vocabulary terms like faces, parallel faces, bases, edges, and vertices.
Then, showing models and having students hold up examples from their Geosolids set build a discussion to help students fill in the information on the "Geometry Words For Three-dimensional Shapes" Foldable.
Lesson Segment 2: Where do we find examples of rectangular prisms, triangular prisms, pyramids, cylinders and spheres in our world?

Have students to complete bottom of Classifying Solids worksheet.
Hand each team a slip of paper with the name of a solid on it. Have the team come up with three characteristics clues using appropriate vocabulary to get others to guess their shape.
Play team challenge: A team reads their clues to the class. The challengers give the class members a couple of minutes to decide what shape is being described and to think of a real world example. The challengers then choose one person to tell the name of their solid and to give a real world example for the solid. If that person is correct, their team gets a point. If not, the challengers must answer and earn a point for their team.

Sphere	Cylinder	Cone	Square pyramid	Triangular pyramid
Cube	Hexagonal Prism	Pentagonal prism	Rectangular prism	Triangular prism

Lesson Segment 3: How are length, width, and height related in the surface area and volume of a prism?
Sing the Perimeter, Area, and Volume Song again. Tell students they will be finding areas on the three-dimensional solids as well as volume for some. Have the students look at the Class Reference Sheet to find the right rectangular prism and the cube. Ask students to look at the formulas for surface areas and discuss with their teams what each of the variables might represent. Q. What does the *l, w, h* stand for in these shapes?
Geometry, Perimeter, Area and Volume Song
(Tune: Farmer In The Dell. Lyrics by Linda Bolin)
You measure along the lines,
You measure along the lines,
If you want to find perimeter,
You measure along the lines.
You cover it up with squares
You, cover it up with squares
If you want to find the area,
You, cover it up with squares
You, fill it up with cubes
You, fill it up with cubes
If you want to find the volume
You, fill it up with cubes
Using the Geosolids again, have students take out rectangular prisms and cubes from the Geosolids. Ask students to think about each of the following questions. After giving them a few seconds to think, ask the question and select one person from each team to show the team using one of the prisms.
Q. Where is an edge that might be measured to find the height? The width? The length?
Q. If I want to find the area of all the faces of the prism, how many faces will I be finding the area for?
Q. How many faces might have exactly the same area on the prism?
Q. What would it mean to find volume of the prism?
Tell class that "face" is part of the word surface, so the surface area includes all the faces. Remind them that volume means the number of cubes needed to fill it up.
Lesson Segment 4: How are length, width and height used to find volume and surface area?
Use the Linker Cubes to demonstrate how to build a rectangular prism by first building the Base layer using the length and width, then using the height to fill up layers.
Give students the worksheet for Linker Cube Volume and Surface area and a bag of Linker Cubes. Do a round robin reading to read all the questions for this worksheet. Show them a 1x2x6 model and a 2x3x4 model that you have made previously. Count the number of cubes in each emphasizing that both prisms have the same volume (number of cubes). Have the student write their hypothesis as

indicated on the top of the worksheet for whether or not the surface areas of the prisms will be the same since the volumes are the same.
Have one pair at each team work together to build prism A on the first problem and the other pair work together to build prism B. When both prisms are built, the team sets the prisms in the center of the desks and discusses the number of cubes needed for volume and the number of squares needed for the area of all the surfaces. Give about 10 minutes for them to build and discuss each set of prisms. Discuss questions and answers for # 1-6 as a class.
Q. Think-Team-Share Did you find any shortcuts for finding the volume so you wouldn't need to actually count the number of cubes? Have them look at the formula for volume of a prism on the Class Reference Sheet. Connect their ideas for finding volume to the formulas. Then, have them answer # 7 on the worksheet.
Q. Did you find any shortcuts for finding the surface area so you wouldn't need to actually count the number of squares on every face? Have them look at the formula for surface area of a prism on the Class Reference Sheet. Connect their ideas for finding surface area to the formulas. Then, have them answer # 8 on the worksheet.
Do Stand-Up-If you predicted two prisms with the same volume (number of cubes) would have the same surface area.
Foldable: Have student cut and staple the index foldable with the cards. Complete the two cards for surface area and volume of a prism.
Lesson Segment 5: How are circumference, radius, and height related in the surface area and the volume of a cylinder?
Have students fold a piece of centimeter paper in half on a line and cut the halves apart. Have them roll one half sheet short way and stick seam together with two small pieces of tape that can be easily undone. Have them fold the other half sheet in half, and cut it. Place the centimeter paper cylinder the paper, trace around the cylinder to make the two bases for the cylinder, then cut the bases out. Tape the bases to the cylinder. Students can count the radius, and they can count the measure of the height .
Q. What is the base shape? What is the lateral area shape?
Do Three-Step Interview:

If we were wrapping or covering up with squares the entire cylinder, what parts would need to be covered?
What are the shapes for each of the covered parts?
What are the formulas for finding the area of each shape?

Have students find the area for the circular bases by counting the radius and using the formula from the Class Reference sheet. Have them find the area for the rectangular lateral area by counting height and width and by using the formula on the Class Reference sheet
Help them see that the circumference is the length of the rectangular lateral surface. Have students look at the formula for finding surface area of a cylinder. They should make notes on the index card for surface area of a cylinder for their foldable.
Point out that Finding *volume* for a cylinder is difficult because stacking cubes in a round shape is not possible. Use a stack of quarters to show them that if they could find the area of the base and stack that up, they could find the volume. Have them look at the formula to see how the area has been multiplied by the height of the cylinder to find the volume.
Have student make notes for finding volume of a cylinder on their index card for cylinder volume.
Lesson Segment 6: Practice and application for finding volume and surface area for prisms and cylinders
Text books and their supplemental materials are filled with procedural practice and real-world problems for finding volume and surface area. Using the problems in a game makes the practice more inviting. Following are suggestions for a couple of games. Some volume and surface area

drawings have been included, if a text or supplemental materials are not preferred.
Game: Basketball
Use a box or trash can as a basket and a foam ball. Place a piece of tape on the floor a few feet from the basket. Divide the class in half. Have students work on a problem, call on one person from Team A to explain and answer. If correct that student gets to stand at the tape line and throw, or ask a teammate to throw for them. Shots are worth 2 points. If the student selected to respond is incorrect, the other team can respond and throw. These correction shots are worth 1 point. Take turns calling on one team and then another for the problems.
Game: Volume and Surface Area Ups and Downs
Ups and Downs Game For Volume and Surface Area
Volume
Materials needed: multisided dice or TI-73 to generate random length, width and height measures, deck of cards without faces, Class Reference Sheets, Overhead of cylinder and right prism
Procedure: Divide the class in half creating teams A and B. Shuffle a deck of cards without the faces to get numbers 1--10. Black cards are positive numbers. Red are negative. The cards will be used to determine team points. The dice or calculator will be used to generate length, width and height or radius and height measures. Have a person from Team A generate 3 numbers to be used for height of a right prism or two numbers to be used to for radius and height of a cylinder. Give class members time to work with their small groups to find the volume before calling on a student.
Both teams start with a score of 0. Choose a student from The A team to explain the problem to the class. The student must read the formula they used and explain how they found the volume. If correct, they choose a card from the deck. Positive numbers are added to their teams score. Negative numbers are added to the other team's score. It is then Team B's turn. If the student explains incorrectly, go to the other team and call on someone to correct. Continue for several problems. The team with the most points at the end of the allotted time, wins.
Surface Area
Materials needed: multisided dice or TI-73 to generate random length, width and height measures, deck of cards without faces, Class Reference Sheets.
Procedure: Divide the class in half creating teams A and B. Shuffle a deck of cards without the faces to get numbers 1--10. Black cards are positive numbers. Red are negative. The cards will be used to determine team points. The dice or calculator will be used to generate length, width and height or radius and height measures. Have a person from Team A generate 3 numbers to be used for dimensions of a right prism or two numbers to be used to for radius and height of a cylinder. The students work to use the numbers in such a way as to give them the greatest possible surface area. Give class members time to work with their small groups to find the volume before calling on a student.
Both teams start with a score of 0. Choose a student from The A team to explain the problem to the class. The student must read the formula they used and explain how they found the surface area. After a student responds, ask the other team if they were able to come up with any greater surface area. If not and if the computations were correct, the chosen student chooses a card from the deck. Positive numbers are added to their teams score. Negative numbers are added to the other team's score. It is then Team B's turn. If the student explains incorrectly, or if the other team found a greater possible surface area, call on someone from that other team to correct. Continue for several problems. The team with the most points at the end of the allotted time wins.

Assessment Plan

Student oral response, performance task, assignment

Bibliography

This lesson plan was created by Linda Bolin.

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