MAT-222-840

Activities for Chapter 11

Name: Solutions

Spring 2017

Date: ____________

Activity 1: Polyhedral nets

For this activity you will need the polyhedral nets packet (1 per team), scissors, and tape.

1. Without cutting anything out, visualize the polyhedron formed by each net. Name them below.

   A: Triangular prism

   B: Hexagonal pyramid

   C: Octagonal prism

   D: Square pyramid

2. Cut out each polyhedron and fold them into solid shapes. Were your guesses correct?

   Yes! I looked at the bases, and whether there was 1 or 2, and whether the sides were rectangles or triangles, told me whether I was looking at a pyramid or a prism.

Activity 2: Euler's Formula

For each of the polyhedra you made in the previous activity, count the number of vertices, edges, and faces in the polyhedron, and record those numbers in the chart below. Verify that Euler's formula holds for each. Then find the listed polyhedra at the front of the classroom and complete the chart for them.

Polyhedron	Vertices	Edges	Faces	Euler's Formula
A	6	9	5	$5+6 \stackrel{?}{=} 9+2 = 11$ ✓
B	7	12	7	$7+7 \stackrel{?}{=} 12+2 = 14$ ✓
C	16	24	10	$10+16 \stackrel{?}{=} 24+2 = 26$ ✓
D	5	8	5	$5+5 \stackrel{?}{=} 8+2 = 10$ ✓
Cube	8	12	6	$6+8 \stackrel{?}{=} 12+2 = 14$ ✓
Trapezoidal Prism	8	12	6	$6+8 \stackrel{?}{=} 12+2 = 14$ ✓
Octahedron	6	12	8	$8+6 \stackrel{?}{=} 12+2 = 14$ ✓
Dodecahedron	20	30	12	$12+20 \stackrel{?}{=} 30+2 = 32$ ✓
Other	12	30	20	$20+12 \stackrel{?}{=} 30+2 = 32$ ✓

Activity 3: Comparing the Volume of a Pyramid with the Volume of a Rectangular Prism

To complete this activity, go to the Activity 3 station.

1. How do the bases and heights of the pyramid and the rectangular prism compare?

They are the same

2. Fill the pyramid with rice, and pour the rice into the prism. Keep filling and pouring until the prism is full. Based on your results, fill in the blanks in the equations that follow:

volume of prism = 3 × volume of pyramid

volume of pyramid = 1/3 × volume of prism

3. How does this relate to the volume formulas for prisms and pyramids?

The volume of a pyramid is 1/3 the volume of a prism with the same base & height.

4. Did your experiment produce exact results? If not, what do you think was the source of the experimental error?

No: The solids were not exactly the same size, and the rice may have packed differently into each container.

Activity 4: Comparing the Volume of a Cone with the Volume of a Cylinder

To complete this activity, go to the Activity 4/5 station.

1. How do the bases and heights of the cone and the cylinder compare?

Same circular base, same height.

2. Fill the cone with rice, and pour the rice into the cylinder. Keep filling and pouring until the cylinder is full. Based on your results, fill in the blanks in the equations that follow:

volume of cylinder = 3 × volume of cone

volume of cone = 1/3 × volume of cylinder

3. How does this relate to the volume formulas for cylinders and cones?

The volume of a cone is 1/3 the volume of a cylinder with the same base and height.

4. Did your experiment produce exact results? If not, what do you think was the source of the experimental error?

No: Again, the solids were not exactly the same size, and there may have been rice-packing differences.

Activity 5: Comparing the Volume of a Sphere with the Volume of a Cone

To complete this activity, go to the Activity 7/8 station.

1. How does the base of the cone compare to the cross-section of the circumference of the sphere?

They are the same. (Not exactly: The sphere cross-section is slightly smaller than the cone base.)

2. How does the height of the cone compare to the radius of the sphere?

Twice the radius of the sphere, or its diameter, is the same as the height of the cone.

2. Fill the cone with rice, and pour the rice into the hemisphere (half of the sphere). Keep filling and pouring until the hemisphere is full. Based on your results, fill in the blank in the following equation:

volume of sphere = 2 × volume of cone

You may return to your desk after completing this part.

3. To see why this is true, complete the following algebraic argument:

Write down the volume formula for a cone, multiplied by the number you wrote in part 2.
This is the volume of a sphere.

$$V_{sphere} = 2(V_{cone}) = 2\left(\frac{1}{3}\pi r^2 h\right)$$

Use the relationship you discovered in part 1 to replace the "h" in the formula with an equivalent expression in terms of "r," the radius of the sphere.

Since $h = 2r$,

$$V = 2\left(\frac{1}{3}\pi r^2 (2r)\right)$$

Simplify the formula until it looks like the formula for the volume of a sphere.

$$V = \frac{2}{3}\pi r^2 \cdot 2r$$

$$\boxed{V = \frac{4}{3}\pi r^3}$$ ← Volume of a sphere formula