Pyramid Dissection: Surface Area

Description: Students find the surface area of a regular pyramid (a pyramid with a regular polygon as its base) using a net that appears side-by-side with a three-dimensional view of the pyramid. They ensure the generality of their results by changing the dimensions and number of sides of the pyramid as they work. By increasing the number of sides, they relate the surface area of the pyramid to the surface area of a cone, giving them an informal opportunity to think about limits.

Technology Strength: This model makes it easy for students to visualize the three-dimensional pyramid and relate it to its two-dimensional net. Controls for pitch, roll, and spin allow students to view the pyramid from different angles. A slider allows students to change the number of sides of the base of the pyramid, and the dimensions can be changed by dragging point. Because they can easily change the number of sides, they are encouraged to develop a general method for finding the area of a regular polygon, and they can relate the surface area of a pyramid to that of a cone.

Objectives: Relate the three-dimensional shape of a pyramid to its two-dimensional net; find a regular polygon area by decomposing it into triangles; generalize from a specific polygon to the general case; measure and calculate to find the surface area of a pyramid; consider how the surface area of a pyramid relates to that of a cone as the number of sides of the base increases

Prerequisites: Ability to find the area of a triangle; familiarity with finding the area of a polygon by dividing it into triangles

Suggested Grade Level: 7 to 10

Sketchpad Level: Intermediate

Suggested Duration: 45 minutes. To complete this activity in a shorter class period, postpone the summarizing discussion to the following class meeting.

Suggested Classroom Setting: Whole Class, Student Pairs. This activity, designed for use by student pairs, can be easily modified for whole-class use.

Preparation: Review the Activity Notes. Cut out the sample net for a pentagonal pyramid on page 6. You may want to print the net on thicker paper or paste it on cardboard before cutting. Make creases for the folds, but leave it unfolded. Preview the student sketch. Work through the steps on the worksheet and make a copy of the worksheet for each student.

Materials: Scissors, tape or glue (for the Explore More)

Student Worksheet(s): Pyramid Dissection

Student Sketch: Pyramid Dissection.gsp

Presentation Sketch: None

Vocabulary: Pyramid, net, regular polygon, surface area, base, lateral face, base, height of a pyramid, slant height, cone
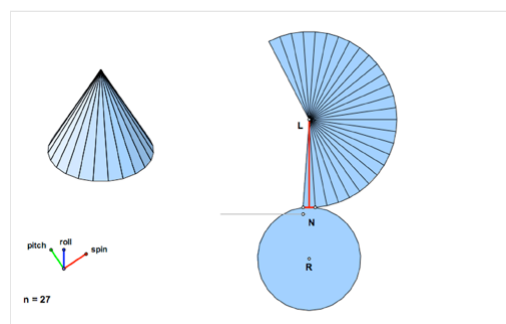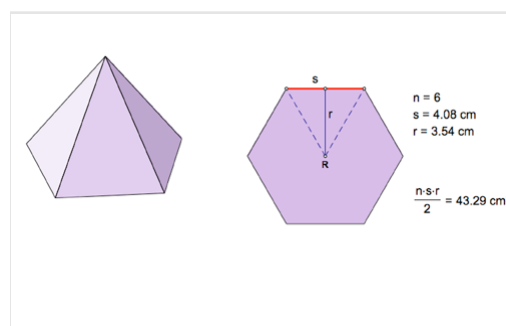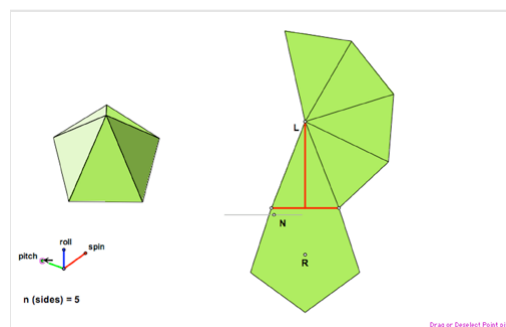
Sketchpad Version: GSP5

Using the Sketch:

In this model, students drag the controls *pitch, roll,* and *spin* to view the pyramid from different angles, as shown in the first illustration. Students control both the three-dimensional and two-dimensional representations by dragging points *L* and *R* to change the dimensions and by dragging point *N* to change the number of sides of the base of the pyramid.

Students decompose the base into triangles and find the area of a single triangle, as shown in the second illustration, and use this result to calculate the area of the entire base. They are guided in this process by pressing *Show Hint*, first on a hexagon, then on a polygonal base of their choosing. Students then find the area of one lateral face of the pyramid and use this result to calculate the total lateral area. From these two results, students calculate the total surface area and develop a formula for the surface area of a regular pyramid.

By changing the number of sides of the pyramid, students investigate the relationship between the pyramid and a cone, as shown in the third illustration. They consider how their formula can be extended to develop a formula for the surface area of a cone.

Sketch Tips:
Sketch Tips show skills needed in this activity, and the step at which the skill is first used.

Sketch Tip	Tip Sheet or Tip Video
Step 1: Change to a different page using page tabs	Moving Between Pages
Step 1: Select, deselect, and drag objects with the **Arrow** tool	Using the Arrow Tool
Step 5: Construct a midpoint using **Construct	Midpoint**	Constructing Points
Step 5: Measure a distance using **Measure	Distance**	Measuring Length and Distance
Step 5: Label an object with the **Text** tool	Using the Text Tool
Step 6: Measure the length of a segment using **Measure	Length**	Measuring Length and Distance
Step 6: Calculate an expression using **Number	Calculate**	Using the Calculator
Step 6: Click a value in the sketch to enter it into the Calculator	Using the Calculator
Step 8: Edit a calculation by double-clicking with the **Arrow** tool	Using the Calculator
Step 14: Open, print, and save a document	Working with Documents