**Activity 3.1.4 The Polygon Angle Sum Theorem**

1. In Activity 3.1.2, you proved the Triangle Angle Sum Theorem. State the theorem here in your own words.

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2. In Activity 3.1.3, you proved the Quadrilateral Angle Sum Theorem. State the theorem here in your own words.

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Now you are going to work on the Polygon Angle Sum Theorem. Recall that a **diagonal** is a line segment connecting nonconsecutive vertices in a polygon. You proved the Quadrilateral Sum Theorem by drawing a diagonal.

Our work will be demonstrated primarily with convex polygons. A polygon is **convex** if each of its diagonals lies completely within the polygon. After completing this activity you may want to discuss whether this theorem also applies to non-convex polygons.

3. On the figure below, draw diagonal $\overbar{AC}$. What type of polygons did you create within polygon *ABCDE*? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
What is the sum of the angle measures for each of the polygons you listed? \_\_\_\_\_\_ and \_\_\_\_\_. Using this information, what is the sum of the interior angles of this pentagon? \_\_\_\_\_\_\_\_\_\_.



4. Do you think this would be true for all convex pentagons? Explain.

5. On the figure below, draw diagonal $\overbar{AC}$. What type of polygons did you create within polygon *ABCDEF*? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. What is the sum of the angle measures for each of the polygons you listed? \_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_. Using this information, what is the sum of the interior angles of this hexagon? \_\_\_\_\_\_\_\_\_\_.



6. Do you think this would be true for all hexagons? Explain.

7. Use the table below to help you make a conjecture about the Polygon Angle Sum Theorem.

|  |  |  |
| --- | --- | --- |
| Number of Sides in the Convex Polygon | Name of the Polygon | Sum of the Interior Angle Measures of the Polygon |
| 3 | Triangle | 180° |
| 4 | Quadrilateral | 360° |
| 5 |  |  |
| 6 | Hexagon |  |
| 7 |  | 900° |
| 8 |  |  |
| 9 | Nonagon |  |
| 10 |  | 1440° |
| *n* | *n*-gon |  |

8. What do you notice about the differences between pairs of values in the right hand column?

9. Hypothesize a formula for the sum of the interior angles of a polygon. Use the graph below to display the data. Label the horizontal axis as “Number of sides”. Label the vertical axis as “Sum of interior angles”. Label axes appropriately and graph the data.



10. Draw a line through the points on the graph. What is the slope of this line? What is the *y*-intercept? What is the *x*-intercept?

11. In your own words, describe the significance of the slope.

12. In your own words describe the significance, if any, of the x- and y- intercepts.

13. Compare your answers to questions 10 through 12 with a classmate. Are your answers the same? Different? Discuss your conclusions and write down your thoughts here.

14. Find an equation for the line your have drawn. See if you can find the equation in two forms:

1. Slope-intercept form (*y = mx* + *b*)
2. Point slope form using the *x* intercept as the point (*y* – *y1 = m*(*x* – *x1*))

15. Use your equation of the line to help you find the sum of angle measures of a polygon with 15 sides.

16. Describe what your equation tells you about the relationship between number of sides and the sum of the measures of the interior angles of a polygon.