Exploring Polygrams

Notes:

- Answers to questions within the lesson are highlighted in yellow.
- An answer sheet corresponding to the worksheet follows the lesson plan
- Potential roadblocks: must follow instructions; they don't hear "label vertices clockwise" and they don't hear or understand what "skip" means; when walking around, once you show those who are not following instructions what to do, they understand and immediately can complete the activity
- Front-loading vocabulary: diagonal of a polygon, items that are adjacent (next to each other) or non-adjacent (not next to each other)

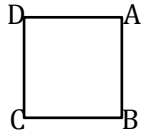
Materials

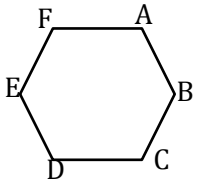
- Exploring Polygram Worksheet: 2 pages

1. Review of polygons

A simple closed curve is made up of only line segments and is called a polygon.
Draw a square and hexagon on the board.
The line segments are called sides, and the point where two sides meet is called a vertex. Plural is vertices.
Today we're going to explore some really cool features of polygons.

2. Go over instructions BEFORE handing out worksheets





In a minute I'm going to handout a paper with six polygons on each side. Let me go over what I want you to do when you get your paper.

To help with the exploration mathematicians label the vertices of a polygon to make it easier to work with the polygon. They use capital letters. If we start with A, go clockwise around the polygon with the lettering. When you get your handout, the first thing you should do is label all the vertices in each polygon.

Label the vertices on your square and hexagon.

The second instruction asked you to fill in number of sides and the number of vertices for each polygon, so simply count an put in the numbers. So, after labeling each polygon you can count number of sides and verteices and fill in the table.

Next you're going to make some diagrams **inside** each polygon. The diagrams are called polygrams. For example, inside the hexagon is a hexagram.

To make the polygrams we need to connect non-adjacent vertices. Let's look at an example on the board. When we connect non-adjacent vertices, we are drawing a **diagonal** of the polygon.

Look at the square. Mathematicians say that the vertices A and B are adjacent to each other, meaning they are next to each other.
ASK: What other vertex is adjacent to A? [D].
ASK: Are A and C adjacent vertices? [No, and we can connect them with a diagonal.]
ASK: Can we draw a diagonal from A to B? [No, the vertices cannot be adjacent since that just gives us a side of the polygon.]

ASK: In the hexagon, what vertices are adjacent to E? [D and F]
ASK: What vertices are non-adjacent to B? [D, E and F]

In the hexagon, I can draw a diagonal from vertex A to vertex C, AC.
ASK: Where can I go from vertex C? [diagonal CE; vertices B and D are adjacent, so they are connected by sides of the hexagon. Drawing diagonal from C to E skips one vertex.]
ASK: Where can I go from vertex E? [only back to vertex A.]
ASK: Were you able to draw a star without lifting your pencil? [no, we got a triangle]
NOTE: When walking around you will see that many students will have drawn a star, BUT, they needed to lift their pencils once they got back to vertex A and start again with vertex B.

3. Handout worksheet

Start with the side that says "**Polygrams Skipping One Vertex.**".

Please go ahead and label all the vertices and fill in the two columns in the table, number of sides and vertices.

You cannot do the last column until AFTER you try to make the polygrams. Go ahead and begin.

Continue with all six polygons.

NOTE: Important to walk around to be sure everyone understood the instructions, and then they can work ahead on their own.

4. Discussion of question 4

After you have draw them all, go back to see if you could draw your polygram without lifting your pencil and complete the table.

4. What is the relationship between the number of sides and whether you can draw the star without lifting your pencil?

After the have drawn their polygrams, have class check back to see which polygrams required you to lift your pencil to get a "real star".
Which figures could be drawn without lifting?

As I walk around I say "what do you see inside your pentagon?" The pentagram divides the space inside the pentagon in regions. The pentagram is made up of what two polygons? How many triangles? How many pentagons?
Can you draw another pentagram inside the new pentagon?

5. Side 2: Skip TWO Vertices

As I see the mathletes finishing up side I tell them to go ahead and do side two. I tell them it is important ot label all the vertieces as that will help in making the polygrams.

Most students are able to do this activity on their onw.

6. Extensions

Color in your polygrams
Start with just the vertices (omit the sides) and draw the polygram.

=== END OF LESSON PLAN ===