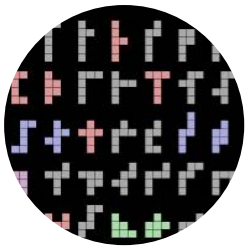

Hexomino Hullabaloo

Area, Perimeter, Spatial Reasoning, and Patterns

Amber Stokes, Cacey Wells
Published by *K20 Center*

Grade Level	6th – 8th Grade	**Time Frame**	90 minutes
Subject	Mathematics	**Duration**	2-3 class periods
Course	Middle School Mathematics		

Essential Question

What relationships exist between the areas and perimeters of all possible formations of hexominoes?

Summary

In this lesson, students will engage in a hands-on learning activity centered around a geometric construct called a hexomino. Similar to the more familiar domino (with two squares fused together on a side), a hexomino consists of six squares fused together. Students will (1) use spatial reasoning skills to find all possible hexomino formations and categorize them, and (2) calculate the perimeter and area of each hexomino to recognize and analyze the patterns that emerge.

Snapshot

Engage

Students are introduced to the game Tetris, then classify different types of tetrominoes.

Explore

Students find all possible hexomino formations.

Explain

Students share strategies for how they characterized and categorized their hexominoes.

Extend

Students measure the perimeter and area of each hexomino and reclassify them based on these properties.

Evaluate

Students complete an Exit Ticket as a check for understanding.

Standards

Oklahoma Academic Standards for Mathematics (Grade 7)

7.GM.1.1: Using a variety of tools and strategies, develop the concept that surface area of a rectangular prism with rational-valued edge lengths can be found by wrapping the figure with same-sized square units without gaps or overlap. Use appropriate measurements such as cm^2.
7.GM.1.2: Using a variety of tools and strategies, develop the concept that the volume of rectangular prisms with rational-valued edge lengths can be found by counting the total number of same-sized unit cubes that fill a shape without gaps or overlaps. Use appropriate measurements such as cm^3.
7.GM.2.2: Find the area and perimeter of composite figures to solve real-world and mathematical problems.

Attachments

- Hexomino-Exploration-Hexomino-Hullabaloo - Spanish.docx
- Hexomino-Exploration-Hexomino-Hullabaloo - Spanish.pdf
- Hexomino-Exploration-Hexomino-Hullabaloo.docx
- Hexomino-Exploration-Hexomino-Hullabaloo.pdf
- Hexomino-Extension-Hexomino-Hullabaloo - Spanish.docx
- Hexomino-Extension-Hexomino-Hullabaloo - Spanish.pdf
- Hexomino-Extension-Hexomino-Hullabaloo.docx
- Hexomino-Extension-Hexomino-Hullabaloo.pdf
- Lesson-Slides-Hexomino-Hullabaloo.pptx

Materials

- Lesson Slides (attached)
- Hexomino Exploration handout (attached; one per student)
- Hexomino Extension handout (attached; one per student)
- Sticky notes
- Pencils
- Paper (copy, graph, or notebook)
- Linking cubes (optional)

Engage

Introduce the lesson using the attached **Lesson Slides**. Display **slide 3** to show students the lesson's essential question. Go to **slide 4** to share the lesson's learning objectives. Review these with students to the extent you feel necessary.

Go to **slide 5**. Inform students that a Russian game designer created Tetris in 1984, and it went on to become one of the most popular video games in history. Explain that the name "Tetris" is derived from the Greek prefix "*tetra*," meaning "four."

Go to **slide 6** and show students the video, titled "Tetris in Minecraft (Stop Motion)."

Embedded video
https://youtube.com/watch?v=vzw0wnPiukQ

After watching the video, go to **slide 7**. Pose the following question to students: *Why do you think the inventor of Tetris used the prefix "*tetra*" to name the game?* Solicit responses from the whole class.

Go to **slide 8** and pose another question to students: *How many types of Tetris pieces are there?*

With this question in mind, have students engage in a Think-Pair-Share activity by completing the following steps:

1. *Think* to themselves for a minute.
2. *Pair* up with an elbow partner to discuss their thoughts.
3. *Share* with the whole class what they discussed with their partners.

Optional Variation: Creating Tetris Pieces

If you have access to manipulatives or want to engage students with drawing, you may give students the option to build or draw the different types of Tetris pieces as they work through their Think-Pair-Share responses.

During the discussion, make sure the whole class comes to a consensus that there are ***only five*** different types of Tetris pieces (tetrominoes).

Rotations, reflections, and translations preserve the image and should not be counted. It is important for all students to understand this key point before they classify hexominoes in the next section.

Explore

This activity tasks students with finding all possible hexomino formations. Doing so engages them in pattern recognition, mathematical justification, and spatial reasoning.

Teacher's Note: What Is a Hexomino?

You likely are familiar with dominoes. A domino is essentially two squares fused together that share a common side. There is only one way to create a domino.

A hexomino is six squares fused together that each share one or more common sides. There are multiple ways to create a hexomino. A net of a cube is one example.

Pass out the attached **Hexomino Exploration** handout to each student. The handout provides basic directions for the activity.

Display **slide 9**. Have students work in pairs to explore the different formations of hexominoes. Students can use pencils and paper, manipulatives (such as linking cubes), or another resource to assist them in organizing, categorizing, and making sense of the hexominoes.

Please do not encourage students to use an internet search to find the answers!

Teacher's Note: Activity Length

This task could take a significant amount of time, depending on students' skill levels.

After allowing plenty of time for students to work through the challenging task, invite students to come to the board and share their answers or preliminary answers. This can be done after students have finished the activity or while they are progressing through the activity (which might be necessary if students are struggling or feeling frustrated).

Use your professional judgment to determine whether it would be worthwhile to have students share their progress and preliminary answers as they work.

Teacher's Note: Want to See All the Hexominoes?

Visit the 35 free hexominoes page on Wikipedia to see images of each hexomino. If you'd like to share this link with students, make sure to wait until after they have had the opportunity to discover the hexominoes for themselves.

Explain

Display **slide 10** and have students form groups of four. Using the 3-2-1 strategy, ask students to take turns discussing the following:

- *Three* things they found interesting about the investigation.
- *Two* observations about how their peers sorted their hexominoes.
- *One* question they still have.

After the 3-2-1 discussion, have students stay with their groups and revisit the Hexomino Exploration handout. Looking at the second question on the handout, ask students to explain how they know they have found all possible hexominoes.

Give students ample time to discuss with their groups and write their justifications.

Extend

Display **slide 11** and pass out the attached **Hexomino Extension** handout to each student.

The first page of the handout shows all 35 free hexominoes. Explain to students that they must calculate the perimeter of each hexomino, then sort the hexominoes into categories based on their perimeters. Students should record their answers in the table on the following pages.

Remind students also to create a key to explain their entries in the "Category for Perimeter" column. On the final page of the handout, ask students to share how many categories they have and how they know they have found them all.

Next, have students find the area of each hexomino and record their answers in the table.

As students work through this part of the activity, they might start to notice all the hexominoes have the same area. If they see this pattern emerging, ask students if they need to calculate each area to know for sure that all the areas are the same. (This is the beginning of mathematical proof.) Ask students to share with their elbow partners how they know all the areas are the same.

Finally, have students work with their partners to determine which hexominoes, when folded, could form cubes. Have students list these hexominoes in the table. On the final page of the handout, have students justify why some hexominoes form cubes when folded while others do not.

Evaluate

To wrap up the lesson, display **slide 12** and give each student a sticky note. Have students complete an Exit Ticket using the How Am I Feeling? What Am I Thinking? strategy.

On one half of the sticky note, ask students to draw how they are feeling about the activity. On the other half, ask students to share what they are thinking now that the lesson is complete. This could be a question, a comment, or a concern.

You may have students post their sticky notes on the board or hand them directly to you before they leave.

Resources

- K20 Center. (n.d.). 3-2-1. Strategies. https://learn.k20center.ou.edu/strategy/d9908066f654727934df7bf4f5059a7b
- K20 Center. (n.d.). Bell ringers and exit tickets. Strategies. https://learn.k20center.ou.edu/strategy/d9908066f654727934df7bf4f505d6f2
- K20 Center. (n.d.). How am I feeling? What am I thinking? Strategies. https://learn.k20center.ou.edu/strategy/fc74060730ea745c8c4f356aa200edfb
- K20 Center. (n.d.). Think-pair-share. Strategies. https://learn.k20center.ou.edu/strategy/d9908066f654727934df7bf4f5064b49
- Nonenmacher, R. A. (2008, September 12). All 35 free hexominoes [Image]. Wikimedia Commons. https://commons.wikimedia.org/wiki/File:All_35_free_hexominoes.svg
- Packkker. (2019, August 9). Tetris in Minecraft (Stop Motion) [Video]. YouTube. https://www.youtube.com/watch?v=vzw0wnPiukQ
- Wikipedia contributors. (2019, April 17). Hexomino. Wikipedia. https://en.wikipedia.org/wiki/Hexomino