# Exploring the Area of Polygons with Geomag

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**TOPIC: Area of Polygons**

**GRADE: 7th Grade**

**APPROACH: Project-Based Learning, Inclusive Classroom**

**DURATION: 2 weeks**

**Summary:** This learning scenario adopts a project-based learning approach to teach students about the concept of area in polygons using Geomag or a similar magnetic construction game. Students will work collaboratively in small groups to explore and apply their understanding of the area formula for various polygons. They will engage in hands-on activities, investigations, and discussions to deepen their understanding of area while developing their critical thinking, problem-solving, and teamwork skills.

## Learning Objectives, Skills and competencies:

What are the main objectives? What skills will the learner develop and demonstrate within the scenario? (e.g. 21st Century Skills).

- Understand the concept of area and its importance in polygons.
- Apply the appropriate area formula for different polygons.
- Develop critical thinking skills through problem-solving and investigations.
- Enhance collaboration and teamwork abilities.
- Foster creativity and innovation in constructing polygons.
- Develop spatial reasoning skills through hands-on activities with Geomag or a similar game.

## Learners' role:

What sort of activities will the learner be involved in?

Students will actively participate in hands-on activities, collaborate in small groups, and engage in investigations to explore and apply the concept of area in polygons. They will take on the role of mathematicians and problem solvers as they construct and analyze various polygons using Geomag or a similar game. They will share their findings, discuss strategies, and present their work to the class.

Funded by the European Union

## Tools and Resources

What resources, particularly technologies, will be required?

- Geomag or a similar magnetic construction game.
- Geometric manipulatives, such as ruler, protractor, and graph paper.
- Interactive whiteboard or projector for class discussions and presentations.
- Internet access for research and exploration of real-life examples of polygons.

## Learning space

Where will the learning take place e.g. school classroom, local library, museum, outdoors, in an online space?

The learning will primarily take place in the school classroom. Students will work in small groups at their desks or in designated collaborative areas. They may also have access to a larger workspace where they can construct and display their polygon creations using Geomag.

## Far Beyond the Barriers Scenario Narrative

Describe in max 10 sentences the main ideas of the scenario

**Introduction (1 class session):**

The teacher introduces the concept of area in polygons and its real-life applications.

Students explore examples of polygons in everyday objects and discuss their significance.

The teacher introduces Geomag or a similar magnetic construction game and its use in exploring polygon constructions.

**Hands-on Exploration and Construction (4 class sessions):**

Students work in small groups and use Geomag to construct various polygons, such as triangles, rectangles, and pentagons.

They measure the sides and angles of the constructed polygons and record their findings.

Students collaboratively discuss the relationship between the measurements and the area of each polygon.

**Investigating Area Formulas (3 class sessions):**

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Students investigate and discover the area formulas for different polygons, such as triangle, rectangle, square, and parallelogram.

They explore the process of deriving the formulas by decomposing the polygons into simpler shapes and using known area formulas.

Students apply the formulas to calculate the areas of their constructed polygons and compare them to their measured values.

**Real-Life Applications (2 class sessions):**

Students research and explore real-life examples where the concept of area in polygons is relevant, such as architecture, city planning, and art.

They identify and analyze the importance of accurate area calculations in these contexts.

Students present their findings through group presentations or multimedia projects.

**Collaborative Problem-Solving (2 class sessions):**

Students engage in problem-solving activities related to the area of polygons.

They collaborate in small groups to solve complex area problems involving irregular polygons or composite shapes.

Groups present their problem-solving strategies and solutions to the class.

**Reflection and Assessment (1 class session):**

Students reflect on their learning journey and the skills they have developed throughout the project.

They discuss challenges they encountered, strategies they used to overcome them, and areas where they have improved.

The teacher provides individual or group feedback, highlighting strengths and areas for further growth.

**Culminating Activity (2 class sessions):**

Students work in groups to design and create a visually appealing display showcasing their constructed polygons, measured values, and calculated areas.

They include explanations and reflections on the importance of accurate area calculations.

The class participates in a gallery walk to observe and appreciate each group's work.

**Presentations and Peer Feedback (2 class sessions):**

Each group presents their display and shares their learning experiences with the class.

Peers provide constructive feedback, ask questions, and engage in discussions to deepen their understanding of the area of polygons.

The teacher facilitates a class discussion summarizing the key concepts and insights gained throughout the project.

**Assessment and Feedback:**

Formative assessment: Ongoing observation, discussions, and questioning to assess students' understanding, engagement, and participation during hands-on activities, investigations, and group work.

Summative assessment: Evaluation of students' final displays and presentations, assessing their understanding of area in polygons, ability to apply area formulas correctly, and their capacity to communicate their findings effectively.

Feedback: Provide timely and constructive feedback to students throughout the project, highlighting areas of growth and offering suggestions for improvement. Encourage self-reflection and peer feedback to foster a supportive and collaborative learning environment.

By engaging in hands-on activities with Geomag or a similar game, collaborative investigations, and real-life connections, this learning scenario aims to deepen students' understanding of the area of polygons. It promotes critical thinking, problem-solving, collaboration, and creativity while fostering a deeper appreciation for the relevance of mathematics in the world around them.

## Learning Activities

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| Warm-up activity | The warm-up activity in this learning scenario serves as an engaging and interactive introduction to the concept of the area of polygons. It aims to activate students' prior knowledge, stimulate their curiosity, and prepare them for the upcoming lesson.<br><br>Activity: Polygon Puzzles<br><br>Introduction: The teacher introduces the warm-up activity and explains its purpose of exploring polygons and their characteristics.<br><br>Materials: Each student or small group of students is provided with a set of polygon puzzle pieces. These can be pre-cut |

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| | paper polygons, magnetic pieces, or virtual puzzle pieces on a digital platform.<br><br>Instructions: The teacher explains that the students' task is to assemble the polygon puzzle pieces to create different polygons. The polygons can range from simple shapes like triangles and squares to more complex ones like pentagons or hexagons.<br><br>Assembly and Discussion: Students work individually or in small groups to assemble the puzzle pieces and create the polygons. As they work, they can discuss the properties of each polygon, including the number of sides, angles, and the symmetry or asymmetry of the shape.<br><br>Reflection and Questions: After the polygons have been assembled, the teacher initiates a class discussion. Students reflect on their process, share their observations, and answer questions such as:<br><br>How did you determine the correct placement of the puzzle pieces to create the polygons?<br><br>What properties do all polygons have in common?<br><br>How do the number of sides and angles vary among different polygons?<br><br>Key Concepts: The teacher summarizes the key concepts related to polygons, emphasizing the importance of sides, angles, and the relationship between them in determining the shape of a polygon.<br><br>The warm-up activity serves as a bridge between students' prior knowledge and the new concept of the area of polygons. It engages them in a hands-on and interactive experience, encouraging them to observe, manipulate, and discuss geometric shapes. |

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| Collaborative work | Collaborative work in this learning scenario plays a crucial role in enhancing students' understanding of the area of polygons. It encourages active participation, cooperation, and peer-to-peer learning. The collaborative work activities are designed to promote teamwork, communication, and problem-solving skills. Here is an explanation of the collaborative work in this learning scenario:<br><br>Group Formation: The teacher divides the students into small groups, ideally consisting of 3-4 members. The groups are formed to ensure a mix of abilities and strengths, fostering a supportive and inclusive learning environment.<br><br>Group Discussions: Students within each group engage in discussions and share their prior knowledge and understanding of polygons and their areas. They brainstorm strategies and approaches for constructing different polygons using Geomag or a similar magnetic construction game.<br><br>Construction and Problem-Solving: Groups collaboratively work with Geomag to construct various polygons. They face challenges and solve problems together, such as ensuring the stability and accuracy of the polygon structures, experimenting with different configurations, and exploring the relationships between sides, angles, and area.<br><br>Peer Teaching and Learning: Within each group, students take turns explaining concepts, demonstrating techniques, and providing guidance to their peers. They share their insights, discoveries, and strategies, which deepens their own understanding while fostering peer learning.<br><br>Reflection and Evaluation: After constructing the polygons, groups engage in reflection and evaluation. They assess the accuracy of their constructions and discuss any difficulties they encountered. They analyze the relationships between the properties of the polygons and their areas, and identify areas for improvement.<br><br>Collaborative Problem-Solving: Groups are presented with challenging problems related to the area of polygons, such as finding the area of irregular polygons or decomposing composite shapes into simpler polygons. They work together to develop problem-solving strategies, analyze the problems, and arrive at solutions collectively.<br><br>*Problem 1: Maximum Area Enclosed* |

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| | *Students are given a fixed perimeter, such as 20 units, and are tasked with creating a polygon with the maximum possible area using that perimeter. They need to experiment with different polygon shapes, such as triangles, rectangles, and pentagons, varying their dimensions to find the configuration that maximizes the enclosed area.*<br><br>*Problem 2: Composite Shape Area*<br><br>*Present a composite shape made up of multiple polygons, such as a figure comprising a triangle, rectangle, and semicircle. The task is to find the total area of the composite shape. Students need to decompose the composite shape into its individual components, calculate the area of each component using the appropriate formula, and then add up the areas to determine the total area of the composite shape.*<br><br>Group Presentations: Each group prepares a presentation to showcase their constructed polygons, problem-solving approaches, and their understanding of the area of polygons. They explain their processes, highlight important observations, and discuss the connections between the properties of polygons and their areas.<br><br>Peer Feedback and Discussion: After each group's presentation, there is a feedback and discussion session. Peers provide constructive feedback, ask questions, and engage in discussions to deepen their understanding of the area of polygons. This collaborative feedback process promotes critical thinking, reflection, and refinement of ideas. |
| Investigation work | Investigation work in this learning scenario provides students with opportunities to explore and deepen their understanding of the area of polygons through hands-on investigations and problem-solving activities. It encourages students to think critically, analyze data, make connections, and draw conclusions. Here is an explanation of the investigation work in this learning scenario:<br><br>Investigative Questions: The teacher presents investigative questions related to the area of polygons, such as:<br><br>How does the area of a polygon change when the side lengths are altered?<br><br>What is the relationship between the area and the number of sides in a regular polygon? |

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| | How can we determine the area of irregular polygons?<br><br>Data Collection: Students work individually or in small groups to collect data through measurements, observations, and calculations. They measure the side lengths, angles, and other relevant properties of the constructed polygons using Geomag or other measuring tools.<br><br>Data Analysis and Patterns: Students analyze the collected data to identify patterns and relationships between the measurements and the corresponding areas of the polygons. They look for commonalities and differences in the data to develop insights and make connections.<br><br>Deriving Area Formulas: Based on their investigations and analysis, students are guided to derive area formulas for different types of polygons. They explore decomposition strategies, dissecting the polygons into simpler shapes and using known area formulas to calculate the areas of the components.<br><br>Application of Area Formulas: Students apply the derived area formulas to calculate the areas of their constructed polygons. They compare these calculated values with the measured areas to evaluate the accuracy of their formulas and deepen their understanding of the relationship between the measurements and the areas.<br><br>Problem-Solving and Extensions: Students are presented with challenging problems related to the area of polygons. These problems may involve irregular polygons, composite shapes, or real-life scenarios where area calculations are required. Students engage in critical thinking and problem-solving activities, applying their knowledge of area formulas to find solutions.<br><br>Reflection and Discussion: Students reflect on their investigative process, observations, and findings. They discuss their strategies, challenges encountered, and insights gained through the investigations. The teacher facilitates class discussions, encouraging students to articulate their thinking, compare approaches, and engage in peer-to-peer learning. |

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| Practice work: | The practice work in this learning scenario provides students with opportunities to reinforce their understanding of the area of polygons through targeted exercises and activities. It allows students to apply the learned concepts, practice using area formulas, and develop their problem-solving skills. Here is an explanation of the practice work in this learning scenario:<br><br>Practice Exercises: The teacher provides a set of practice exercises that focus on different aspects of finding the area of polygons. These exercises may include calculating the area of regular polygons, finding the missing side lengths or angles given the area, or solving word problems involving polygonal areas.<br><br>Exercise 1: Finding the Area of Regular Polygons<br><br>Find the area of a regular hexagon with a side length of 8 cm.<br>Calculate the area of a regular octagon with a side length of 12 meters.<br>Determine the area of a regular pentagon with a side length of 6 inches.<br>Exercise 2: Finding the Area of Irregular Polygons<br><br>Calculate the area of an irregular quadrilateral with side lengths of 5 cm, 8 cm, 6 cm, and 9 cm.<br>Find the area of an irregular pentagon with side lengths of 7 meters, 5 meters, 9 meters, 6 meters, and 4 meters.<br>Determine the area of an irregular hexagon with side lengths of 12 inches, 9 inches, 8 inches, 10 inches, 7 inches, and 5 inches.<br>Exercise 3: Finding Missing Measurements<br><br>Given an equilateral triangle with an area of 36 square units, find the length of each side.<br>Calculate the area of a rectangle with a length of 10 cm and a width of 6 cm.<br>Find the area of a parallelogram with a base of 12 meters and a height of 8 meters.<br>Exercise 4: Problem-Solving<br><br>A garden is in the shape of a regular hexagon with a side length of 5 meters. Find the area of the garden.<br>A triangular piece of land has side lengths of 12 meters, 9 meters, and 15 meters. Calculate the area of the land. |

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| | A trapezoid has a height of 7 cm, a base of 5 cm, and a top length of 3 cm. Determine the area of the trapezoid.<br><br>Independent or Small Group Work: Students work individually or in small groups to solve the practice exercises. They use the area formulas for different polygons, apply their understanding of geometric properties, and utilize problem-solving strategies.<br><br>Error Analysis and Corrections: After completing the exercises, students engage in an error analysis process. They review their work, identify any errors or misconceptions, and correct them. This process encourages students to reflect on their solutions, analyze their mistakes, and deepen their understanding of the area concepts.<br><br>Extension Challenges: For students who demonstrate proficiency in the practice exercises, additional extension challenges can be provided. These challenges can involve more complex polygons, non-standard shapes, or advanced problem-solving scenarios to further stretch their thinking and application of the area concepts.<br><br>Peer Discussions: Students engage in peer discussions to compare approaches, share strategies, and discuss alternative solutions. This collaborative dialogue encourages students to learn from each other, consider different perspectives, and refine their understanding of the area of polygons.<br><br>Teacher Support and Guidance: The teacher circulates among the students, providing support, clarification, and feedback as needed. The teacher addresses any misconceptions, provides additional explanations, and scaffolds students' learning to ensure they grasp the underlying concepts. |
| Producing work | The producing work in this learning scenario involves students demonstrating their understanding of the area of polygons by creating original work or artifacts. Each student may choose one of the tasks below. It provides an opportunity for students to showcase their knowledge, creativity, and application of the learned concepts. Here is an explanation of the producing work in this learning scenario:<br><br>Designing a Polygon Poster: Students create a visually appealing poster that highlights key concepts, formulas, and examples related to the area of polygons. They can use |

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| | illustrations, diagrams, and written explanations to communicate their understanding. The poster can serve as a reference tool for themselves and their peers.<br><br>Creating a Polygon Area Handbook: Students develop a comprehensive handbook or booklet that explains different types of polygons, their properties, and the corresponding area formulas. They can include step-by-step instructions, examples, and problem-solving strategies. The handbook can be a valuable resource for future learning and review.<br><br>Designing a Digital Presentation: Students create a digital presentation using tools like PowerPoint or Google Slides. They showcase their understanding of the area of polygons by explaining concepts, demonstrating calculations, and presenting examples. They can incorporate visuals, animations, and interactive elements to engage their audience.<br><br>Building a 3D Polygon Model: Students use various materials, such as clay, craft sticks, or 3D printing, to construct physical models of different polygons. They ensure that the models accurately represent the shape, proportions, and dimensions of the polygons. This hands-on activity reinforces their understanding of spatial relationships and the concept of area.<br><br>Writing a Real-World Application: Students explore real-world scenarios where knowledge of polygonal areas is applicable, such as designing a garden, planning floor layouts, or calculating material requirements for a construction project. They write a detailed report or proposal that incorporates area calculations and explains the practical significance of their work.<br><br>Creating an Interactive Online Quiz: Students develop an interactive online quiz or game using platforms like Kahoot or Quizlet. The quiz can include multiple-choice questions, fill-in-the-blanks, and problem-solving scenarios related to the area of polygons. This activity engages their peers in a fun and interactive way, while assessing their understanding. |
| Discussion | The discussion component in this learning scenario provides students with an opportunity to engage in meaningful conversations about the area of polygons. It encourages active participation, critical thinking, and collaborative learning. |

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| Presentations | The presentations component in this learning scenario provides students with an opportunity to showcase their understanding of the area of polygons and share their knowledge with their peers. It encourages effective communication, public speaking skills, and the ability to present complex ideas in a clear and organized manner. |
| Assessment and feedback | The assessment and feedback component in this learning scenario focuses on evaluating students' understanding of the area of polygons and providing constructive feedback to support their learning. It aims to assess their knowledge, skills, and application of concepts while promoting growth and improvement. |
| Pedagogical Tips for Teachers Regarding Special Needs of Students with Learning Difficulties | Individualized Instruction: Recognize that each student with learning difficulties has unique needs. Provide individualized instruction and support tailored to their specific learning styles, strengths, and challenges. Adapt teaching strategies, materials, and assessments to meet their needs.<br><br>Differentiation: Implement a differentiated approach to instruction. Vary the content, process, and products to accommodate diverse learning styles and abilities. Provide multiple means of representation, engagement, and expression to ensure all students can access and demonstrate their understanding.<br><br>Multi-Sensory Instruction: Engage students with learning difficulties through multi-sensory instruction. Incorporate visual aids, manipulatives, auditory cues, and kinesthetic activities to reinforce concepts and improve comprehension. This approach helps cater to different learning modalities and enhances retention.<br><br>Chunking and Simplification: Break down complex tasks or concepts into smaller, more manageable parts. Use step-by-step instructions, visual organizers, and simplified language to help students with learning difficulties understand and navigate through the content. This approach reduces cognitive overload and supports comprehension.<br><br>Explicit Instruction: Provide explicit and direct instruction by clearly stating learning objectives, modeling processes, and providing guided practice. Clearly explain expectations, provide examples, and offer guided support to help students grasp new concepts and skills. Gradually release responsibility as they gain confidence and independence. |

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| | Assistive Technology: Utilize assistive technology tools and resources to support students with learning difficulties. These may include text-to-speech software, speech recognition tools, graphic organizers, or screen readers. Assistive technology can enhance accessibility, promote independence, and facilitate learning for students with diverse needs.<br><br>Flexible Assessment: Adapt assessment methods to accommodate the needs of students with learning difficulties. Provide alternative formats, extended time, or modified tasks to enable them to demonstrate their knowledge and skills. Consider a range of assessment strategies, such as verbal presentations, visual representations, or hands-on activities.<br><br>Positive Reinforcement and Support: Foster a positive and supportive learning environment. Recognize and celebrate the strengths, efforts, and achievements of students with learning difficulties. Use positive reinforcement, praise, and rewards to motivate and build their self-confidence.<br><br>Collaboration and Communication: Foster open lines of communication with students, their families, and other professionals involved in their education. Collaborate with special education teachers, learning support staff, and therapists to ensure a coordinated approach. Regularly communicate progress, challenges, and strategies to support the student's learning journey.<br><br>Patience and Empathy: Show patience, understanding, and empathy towards students with learning difficulties. Recognize that they may face unique challenges and may require additional time and support to grasp concepts. Create a safe and inclusive classroom environment where mistakes are seen as opportunities for growth and where students feel valued and supported. |