Area Architects for Tennessee Teachers (Grades 3-5)

TN Math Standards:

3rd Grade:

Recognize area as an attribute of plane figures and understand concepts of area measurement

a. A square with side length 1 unit, called "a unit square," is said to have "one square unit" of area, and can be used to measure area.
b. A plane figure which can be covered without gaps or overlaps by *n* unit squares is said to have an area of *n* square units.

Measure areas by counting unit squares.

Solve real world and mathematical problems involving perimeters of polygons, including finding the perimeter given the side lengths, finding an unknown side length, and exhibiting rectangles with the same perimeter and different areas or with the same area and different perimeters.

Understand that shapes in different categories may share attributes and that the shared attributes can define a larger category. Recognize rhombuses, rectangles,and squares as examples of quadrilaterals, and draw examples of quadrilaterals that do not belong to any of these subcategories.

Partition shapes into parts with equal areas. Express the area of each part as a unit fraction of the whole.

4th Grade:

Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams.

Apply the area and perimeter formulas for rectangles in real world and mathematical problems.

5th Grade:

Convert among different-sized standard measurement units within a given measurement system, and use these conversions in solving multi-step, real world problems.

Source for Activity:

CPALMS Lesson Plan Development Initiative, Area Architects, Lesson 1.
http://www.achieve.org/files/Area%20Architects%2C%20Final_0.pdf

Area Architects, Lesson 1

Resource ID#: 28353 Primary Type: Lesson Plan

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In this unit on area, students explore geometric measurement by becoming "Area Architects" in order to learn the concepts of area. Using all five lessons will allow the students to discover, explore and eventually relate area to multiplication and addition. This lesson is the introductory lesson of the unit. In Lesson 1, students will develop strategies for finding area by counting square units. Students will learn the importance of accurately measuring area by exploring the concepts of area in realistic applications.

Subject(s): Mathematics

Grade Level(s): 3

Intended Audience: Educators

Suggested Technology: Document Camera, Computer for Presenter, Interactive Whiteboard, LCD Projector, Adobe Acrobat Reader, Microsoft Office

Instructional Time: 1 Hour(s) 30 Minute(s)

Resource supports reading in content area: Yes

Freely Available: Yes

Keywords: area, square units, unit squares, counting, measurement, floor plans, plane figures, architects, architecture

Instructional Component Type(s): Lesson Plan

Resource Collection: CPALMS Lesson Plan Development Initiative

ATTACHMENTS

Floor Plan Discoveries.docx
Choose a Room.docx
What I Know-area.docx
Summative Assessment area.docx
New Home Floor Plan.pdf

LESSON CONTENT

Lesson Plan Template: Learning Cycle (5E Model)

Formative Assessment

Before beginning this lesson, have students complete the "What I Know" form. For this lesson students will need to

- know basic plane figures and be able to count square units.
- know how to order numbers.
- be familiar with basic measurement units (cm, m, in, and ft).

Assess the completed "What I Know" forms.

- If students are unable to identify the basic shapes, explicitly teach them the difference between a rectangle and a square. A rectangle is a 4-sided flat shape with straight sides where all the interior angles are right angles (90 degrees), opposite sides are parallel and opposite sides ar equal in length. Students should understand that a square is a special kind of rectangle where all four sides are equal in measure.
- If students are unable to count square units, explicitly teach them strategies for accurately counting squares. Start counting from the top left and continue counting towards the right, like reading. Show students how to mark the squares they have already counted so they won't get confused about which squares they have or have not counted.
- If students are unable to order numbers, explicitly teach them to look for key words when ordering numbers (i.e., largest, smallest, greatest, least). If students are unable to determine the best unit of measurement for objects, give them examples of common objects to associate with each measurement (i.e., centimeter/grain of rice, meter/arm span, inch/finger joint, foot/textbook).

Throughout the lesson:

- "Choose A Room" activity can also be used as formative assessment in the middle of the lesson. This worksheet asks students to show what they have learned after working on the "New Floor Home Plan" activity. The teacher should remediate any misconceptions at this point. The teacher could use other students' answers and explanations to address the misconceptions. This will allow for continued use of Mathematical Practice 3: construct viable arguments and critique reasoning of others by asking the class specific questions that address the misconceptions.
- Discussion times can also be used to assess the students' progression and conceptual understanding. Teacher should address any misconceptions as they form.

Feedback to Students

During the lesson, students will work in small groups and with partners to find the area of different rooms on floor plans. Students will explore area using a variety of manipulatives to allow for success in representing a given area. Whole group discussion will also allow for the correct explanation of ideas explored.The teacher will monitor the groups' progress and provide directed and corrective feedback during exploration and elaboration. One mathematical concept to be looking for is the proper use of labels. Students should take care to write and orally refer to the areas in terms of square units, square centimeters, square inches, etc.

During exploration, students should count the squares to find the area of the rooms. Check to see that students are counting accurately. If you see inaccuracies, ask students how they know if they already counted a square or not. Ask them if they can think of a way to know if they have already counted a square. Tell them to count at least twice. The teacher should monitor for possible confusion if they include the closet space as part of the bedroom's area or when counting the squares for bedroom 3, as the one wall is not as clearly defined as in the other rooms. Check to see that students are writing down their findings on the "Floor Plan Discoveries" form. If students are not using the counting the square units method, ask them to explain their method and how they know which is the largest or second largest and so. For students that use a method such as, overlaying the larger bedroom or visually comparing the rooms, ask more specific questions that make the student use other methods. For example, "How much larger is bedroom 2 then bedroom 3?" etc. These questions will direct the student more towards a counting or calculation method, leading them to the crux of the lesson.

During elaboration, each team/pair should choose their favorite design. Each team/pair must choose only one design, which may frustrate some students. Talk to students about how they can compromise. If time allows, students may choose two designs to build using the color tiles. While students model their ideal rooms with the color tiles and paper squares, address overlapping and gaps. Discuss the importance of measuring area without overlaps and gaps.

Summative Assessment

Students will be individually assessed using the "Summative Assessment" form. Students will need to demonstrate an understanding of area by completing the summative assessment form which requires them to use appropriate mathematical reasoning and vocabulary to explain their thinking. Any students who are unsuccessful can be remediated in a small group with direct teacher instruction.

Learning Objectives: What will students know and be able to do as a result of this lesson?

- Students will recognize area as an attribute of plane figures and that full, half or quarter of areas can be found.
- Students will discover that square units measure area and that the square units must not have gaps or overlap.
- Students will measure areas by counting unit squares.
- Students will use a variety of square units to represent models of rooms, including square centimeters, square inches, square feet and squares on grid paper.

Guiding Questions: What are the guiding questions for this lesson?

- What is area?
- How can we find the area of a plane figure?
- How can we measure area?
- What is "one square unit"?
- Why is it important not to overlap square units or have gaps?
- How can we determine fractional parts of area using models?
- Is there more than one way to arrange a floor plan that has the same area?

Prior Knowledge: What prior knowledge should students have for this lesson?

This is an introductory lesson in a unit on area. Students will need to know basic plane figures (rectangles and squares) and be able to count square units. Students should know how to order numbers. Students need to be familiar with basic measurement units (cm, m, in, and ft). Before beginning this lesson, have students complete the "What I Know" form. A few questions address finding half and a quarter of the area of the rooms. This concept is explored using models to help bridge the fractional concept and area concept.

Engage: What object, event, or questions will the teacher use to trigger the students' curiosity and engage them in the concepts?

1. Introduce to the students that in this unit they will be "Area Architects". Ask the students if they know what an an architect is and what they do. Elicit ideas and focus the conversation and answer towards: a person trained in the planning, design and supervision of the construction of buildings. Architects use floor plans to show their designs.
2. Ask the students if they know what a floor plan and/or a scale drawing is. Elicit ideas and focus the conversation and answer towards: A floor plan is a drawing to scale, showing a view from above, of the relationships between rooms at one level of a structure. A scale drawing shows a real object with accurate sizes except that they have all been reduce or enlarged by a certain amount called the scaled. If real examples of floor plans or blue prints are available show the students.
3. Ask the students how they would determine the overall size of a room and/or in a floor plans.Elicit ideas and focus the conversation and answer towards: measuring the room with a standard unit of measure to see how much space the room takes up. Students may say, "see how much stuff fits in the room, see how many times they can lay across the room, etc" If this occurs, lead the discussion to the usefulness of using standard measures that cover the floor of the room. Ask the students what shape would be the best to use to cover the floor of a room. Direct the conversation to a square and how squares would fit with no gaps or overlays and the orientation of it would not matter, unlike circles or triangles or rectangles. Be sure not to give away to much information, as this is a discovery lesson. Students should be able to connect the discussion to the floor plan's grid in the upcoming activity.
4. Excite the students by telling them that their parents are thinking of buying a new house and you have the floor plan of the house they are thinking of buying.
5. Show the students the floor plan of the house, and challenge them to decide which room they would like to be their room. Explain that the house has four bedrooms, and their parents want the largest bedroom. Students will need to decide which room they want out of the three remaining bedrooms. Ask students what features they would like in their bedroom. Ask what shape and size they would like their room to be. Most students will respond that they would like the largest room possible. Since their parents will naturally claim the largest room, tell students their task will be to find the second largest bedroom. Tell students they can claim the second largest bedroom as their own if they would like the largest of the children's bedrooms. However, if they prefer a different room, students need to provide the area of the room that they chose.

Time for Engage: 5-10 minutes

Explore: What will the students do to explore the concepts and skills being developed through the lesson?

1. Tell students that they will be working in groups of four to explore the floor plan of the new house (Standards for Mathematical Practice 4: Model with mathematics).
2. Explain that students will need to figure out how to find the second largest bedroom on the floor plan. Provide the "New Home Floor Plan" to each group of four students.
3. Allow students time to explore the floor plan and come up with ways of finding the area of each room. The floor plan is on a grid, so students should discover that they can find the area of each room by counting each square in the room.
4. Monitor students and provide feedback to ensure they are correctly identifying the area of each room.
5. Have students write down their discoveries on the "Floor Plan Discoveries" form. If students prefer a room other than the second largest, then they need to write the area of the room that they chose on the "Floor Plan Discoveries" form
    - Challenge students that are ready to move on by providing the enrichment sheet. This sheet focuses on determining the area of the rooms with at least 42 square units and to find the area of other rooms in the house (e.g. kitchen, dining room, breakfast room, living room, foyer, etc.).
    - Students that are struggling could focus only on comparing the areas of bedroom 1 and bedroom 2.

Time for Explore: 20 minutes

Explain: What will the students and teacher do so students have opportunities to clarify their ideas, reach a conclusion or generalization, and communicate what they know to others?

1. Have students come back together as a whole group.
2. Display the floor plan using a document camera or white board technology.
3. Ask students to share their discoveries. (Standards for Mathematical Practice 6: Attend to precision)Write down the area of the rooms as students share the area of each room.
    - Ask which bedroom they want as their own bedroom. Ask which bedroom is the largest.
    - Ask which bedroom is the second largest.
    - Ask which bedroom is the third largest.
    - Ask which bedroom is the smallest.
    - Ask if any students found the area of any of the other rooms (i.e., kitchen, bathroom, etc.).
    - Ask students how they knew the sizes of the rooms. Responses should include that they counted the squares in each room.
    - Ask students what the number of squares they counted indicates.
4. Have students critique reasoning of others (Standards of Mathematical Practice 3: Construct viable arguments and critique the reasoning of others). The teacher can use this discussion as formative assessment.
5. Discuss the explanations given, and lead students to see they have defined area. Listen for and elicit statements such as:
    - Area is how much space is inside the shape.
    - We can count the squares inside the shape and call them square units.
    - Square units can be different sizes, like the small squares on the paper, the square tiles, and the large squares of paper.
    - The small squares on the floor plan are square centimeters.
    - The floor plan we used is a model.
    - Models are important in mathematics and science.
    - Formal definition of area is: the amount of square units needed to cover the flat surface

Time for Explain: 15 minutes

Elaborate: What will the students do to apply their conceptual understanding and skills to solve a problem, make a decision, perform a task, or make sense of new knowledge?

1. Again, excite the students by telling them that they will look at some different floor plans for an ideal bedroom. Students will work in pairs to find the area of each of the room designs. Each pair of students will need to choose their favorite room design. They can choose only one design per pair of students. Provide students with the "Choose a Room" form. Allow time for students to work together to find the area of each room and decide on their favorite. Note: The area of each room is 16 square units (Standards for Mathematical Practice 4: Model with mathematics). This activity can be used for formative assessment.
2. Next, tell students they will use color tiles to show their ideal room that they chose from the "Choose a Room" form. Tell students that the color tiles are square inches. Provide pairs of students with color tiles to represent their ideal room. Monitor students as they construct their floor plan. Provide feedback to ensure students are representing the room they chose from the "Choose a Room" form.
3. Challenge the students to create with the tiles, other layouts of a room that is also 16 square units. Have students compare and contrast their designs with their neighbors, noting the variety and options. (Standards of Mathematical Practice 3: Construct viable arguments and critique the reasoning of others).
4. Add a twist to challenge by telling the students that their cousin is coming to stay for the summer and needs half of the bedroom. Have the students divide the room they created in half by slightly pulling apart the tiles. Have students compare and contrast how they divided the room, making sure the division produces 8 tiles each. Have students compare and contrast their designs with their neighbors, noting the variety and options. (Standards of Mathematical Practice 3: Construct viable arguments and critique the reasoning of others). Have students return to their grid paper and draw a division line on the first room to represent half. Direct them to shade in half the room their cousin will use.
5. Repeat the fractional division of area challenge, using quarters this time and the tiles. Transition from tiles to the grid paper and have students divide the second room into fourths, shading in one fourth of the room.
6. To transition to larger scaled units and the use of models: Discuss the differences between the room on the paper and the room students built with the color tiles. The only difference should be size of square units. Ask students if the tiles represent how big their room will actually be when it is built. Explain that the room will be the same shape but a different size and that it is a model of the room. Tell students that we will attempt to build their room on a larger scale, a more real life scale. Many classrooms have tiles that are 1 square foot, this could be used for demonstration of a real life scale.
7. For this portion of the lesson, you may need to go outside or to a large open room to provide enough space for students to represent their ideal room using square feet. Make sure students bring their worksheet with them. Provide students with 16 pieces of poster paper or bulletin board paper cut into one square foot pieces. Have students represent their ideal room from the "Choose a Room" form using square feet. Provide corrective feedback as students build their models. Address overlapping and gaps when students are building their representations. Discuss the importance of measuring area without overlapping and gaps. If obtaining the materials for each pair of students is an issue, teachers can have groups model each of the choices to the whole group using one set of square foot pieces.
8. Discuss the differences between the three representations of the ideal room students built (Standards for Mathematical Practice 6: Attend to precision and Standards for Mathematical Practice 3: Construct viable arguments and critique the reasoning of others).
9. Again, elicit student ideas about the difference is in the size of the representation. Discuss the practicality of each representation. Which is "best"? Help students to realize the size of the representation depends on the purpose of it. Are we using it to show details of a bedroom? Are we using it to show the bedroom compared to the whole house? Are we using the floor plan to compare it to the size of other houses in the neighborhood? Ask students if architects should draw the room on a piece of paper

the actual size that the room will be. Ask how much paper we would need? Ask students what measurement unit we might use to represent the actual size of the room. Listen for student ideas about why models are used. Listen for statements such as, "Since it is not always possible to draw on paper the actual size of real-life objects we need to scale drawings to model the size of the object."

Time for Elaborate: 30 - 45 minutes

ACCOMMODATIONS & RECOMMENDATIONS

Accommodations:

- Struggling students should be strategically paired to allow for peer support.
- Teacher should monitor and assist students during the exploration and elaboration of the lesson by providing directed and corrective feedback (e.g. Should the tiles overlap? Did you count the squares at least twice? How can you be sure your findings are accurate?).
- Explicit modeling of strategies for counting square units can be provided to struggling students (e.g. clearly mark each square as it is counted).
- Students use a variety of manipulatives which will help visual and tactile learners.
- Provide English Language Learners with translations, definitions, and examples for unfamiliar vocabulary.
- Provide students that need remediation with less rooms to count. Either provide an easier floor plan, or instruct them to only compare bedroom #2 and bedroom #1.
- Challenge opportunities and extensions are incorporated for gifted learners as an attachment to the Floor Plan Discoveries Sheet. To extend enrichment activities, an early connection to multiplication and more efficient ways then counting can occur. Ask students to develop an quicker way then counting and see what methods they discover. In addition, students could be challenged to rearrange rooms using the tiles, but to have the least perimeter. Other challenges could include to create, with tiles, a 20 square unit room. They could then trace the rooms or recreate them on a grid to transition from concrete to more abstract methods of area.

Extensions:

The class as a whole can attempt to construct a life-sized representation of an ideal house using square feet and different color tiles for each room. Masking tape then could be placed on the floor to define each room. This could lead to a discussion on perimeter.

Challenge students to create 5 ideal rooms using a given area and scaled measure of their choice. Students can do this with tiles or on grid paper.

Suggested Technology: Document Camera, Computer for Presenter, Interactive Whiteboard, LCD Projector, Adobe Acrobat Reader, Microsoft Office

Special Materials Needed:

Color tiles in square inches (at least 16 per pair of students)

Poster or bulletin board paper cut into square ft units (16 per pair of students)

Examples of blue prints and floor plans (optional)

Further Recommendations:

Be prepared to address overlapping and gaps when students are building their representations using color tiles and paper squares. Discuss the importance of measuring area without overlapping and gaps.

This is the first lesson of a five lesson unit. See Area Architects, Lessons 2 - 5 for further exploration of understanding the concept of area and relating area to multiplication and addition.

Additional Information/Instructions

By Author/Submitter

This is the first lesson of a five lesson unit on area: Area Architects Lesson 2,3,4,5.

This lesson addresses multiple Mathematical Practices:

MAFS.K12.MP.3: Construct viable arguments and critique the reasoning of others.

MAFS.K12.MP.4: Model with mathematics.

MAFS.K12.MP.6: Attend to precision.

SOURCE AND ACCESS INFORMATION

Contributed by: Katrina Roddenberry
Name of Author/Source: Katrina Roddenberry
District/Organization of Contributor(s): Wakulla
Is this Resource freely Available? Yes
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Related Standards

Name	Description

MAFS.3.MD.3.5:	Recognize area as an attribute of plane figures and understand concepts of area measurement. a. A square with side length 1 unit, called "a unit square," is said to have "one square unit" of area, and can be used to measure area. b. A plane figure which can be covered without gaps or overlaps by *n* unit squares is said to have an area of *n* square units.
MAFS.3.MD.3.6:	Measure areas by counting unit squares (square cm, square m, square in, square ft, and improvised units).
MAFS.3.G.1.1:	Understand that shapes in different categories (e.g., rhombuses, rectangles, and others) may share attributes (e.g., having four sides), and that the shared attributes can define a larger category (e.g., quadrilaterals). Recognize rhombuses, rectangles, and squares as examples of quadrilaterals, and draw examples of quadrilaterals that do not belong to any of these subcategories.
MAFS.3.G.1.2:	Partition shapes into parts with equal areas. Express the area of each part as a unit fraction of the whole. *For example, partition a shape into 4 parts with equal area, and describe the area of each part as 1/4 of the area of the shape.*

Resources in the CPALMS Lesson Plan Development Initiative

Lesson Plan

Name	Description
Area Architects, Lesson 2:	In this unit on area, students explore geometric measurement by becoming "Area Architects" in order to learn the concepts of area and relate area to multiplication and addition. This lesson is the second of a five lesson unit. In this lesson, students will develop strategies for finding the area of rectangles with whole-number side lengths by tiling it, and show that the area is the same as would be found by multiplying the side lengths.
Area Architects, Lesson 4:	In this 5-lesson unit on area, students explore geometric measurement by becoming "Area Architects" in order to learn the concepts of area and relate area to multiplication and addition. In this 4th lesson, students will use tiling to show in a concrete case that the area of a rectangle can be found using the Distributive Property of Multiplication. This lesson is focused on single-digit x single-digit dimensions using proper units for dimensions (e.g. ft, yd, m) and square units for the area (e.g sq. ft, sq. yd, sq. m).
Area Architects, Lesson 5:	In this unit on area, students explore geometric measurement by becoming "Area Architects" in order to learn the concepts of area and relate area to multiplication and addition. This lesson is the fifth and final lesson of the unit. In this lesson, students will recognize area as additive. Students will find areas of rectangular figures by decomposing them into non-overlapping parts in order to solve a real world problem. This lesson is focused on single-digit x single-digit dimensions using proper units for dimensions (e.g. ft, yd, m) and square units for the area (e.g sq. ft, sq. yd, sq. m).
Area Architects, Lesson 3:	In this unit on area, students explore geometric measurement by becoming "Area Architects" in order to learn the concepts of area and relate area to multiplication and addition. This lesson is the third of a five lesson unit. In this lesson, students will apply strategies learned for finding the area of rectangles with whole-number side lengths after creating floor plans for their dream home on 1-inch grid paper, and represent whole-number products as rectangular areas.