This unit plan provides a good example of how a variety of instructional strategies can be used to differentiate instruction throughout a unit. Differentiation on the basis of readiness, interest and learning profile are evident through the use of tiered activities, interest-based activities selected by the students, and projects geared to learning preferences.

The availability of anchor activities at different readiness levels will ensure that students have a task to independently work on if they complete an activity before other members of the class. At the start of the unit, the teacher assigns each student to one of several anchor activity folders that are color-coded according to readiness levels. The folder color assignment can be easily modified as the teacher sees a change in the readiness level of a student.

During the unit, the students work in a variety of grouping configurations, which helps to eliminate the sense of tracking that can often occur in a math class.

One concern – the analytical task of the final project in lesson five does not present the complexity of challenge or address the range of learning goals evidenced in the practical or creative tasks.

Perimeter and Area – a Mathematics Unit for Grade 4

Developed by Adam Hoppe, graduate student, Curry School of Education, University of Virginia, Charlottesville, VA

Introduction

This short unit, based on Virginia state standards for fourth grade mathematics, examines rectangular shapes and the relationship between their areas and perimeters. The goal is to provide students with the ability to measure these features, understand that perimeter and area have a relationship, and recognize and apply their new knowledge in real-life applications.

The unit builds on previous work that fourth graders have done with linear measurement.   It begins with a pre-assessment which will help the teacher make decisions about student readiness, which is used to guide several activities that are differentiated based on readiness.   A literature connection provides a "hook" as well as an intuitive way of thinking about perimeter and area before students move into working with customary units.

Background Information for the Unit

In this unit I wanted to explore some deeper understandings about perimeter and area. For example, the fact that different shapes can have different areas but the same perimeter (or different perimeters but the same area) is not necessarily self-evident. This understanding can help form connections to interesting real-life

applications of the mathematics, where an optimal solution can be sought (e.g. the least amount of fencing used to surround an enclosure for a dog, etc.).

In planning the unit, I looked at the state standards in mathematics for various grades and noticed that this material is also taught in the second grade. However, it is unlikely that all students will have retained a perfect understanding of these concepts. Given that students will be at varying states of readiness related to prior knowledge and the measurement and multiplications skills needed for this unit, I knew I would have to differentiate based on readiness. I also wanted to differentiate based on interest and learning style when possible because I wanted to provide choice, foster a sense of personal competency, and not least because I wanted to keep the lines between high and low readiness students as blurred as possible.

There is a tension in this unit between exploring the concepts and the limited time typically allocated for study of these topics.   At this point in the year (this unit is taught in the spring in my district), students will already be familiar with many of the manipulative tools and classroom routines which support the learning activities – this should help students to get down to work quickly. Though student learning will eventually be assessed via the Virginia multiple-choice SOL test, this unit relies primarily on hands-on tasks. I believe that knowledge, skills and understandings developed in this way will be more enduring, and will transfer to paper-and-pencil tests.

Mathematics Standards Addressed:

Virginia Standards of Learning:

4.13   The student will
   a) identify and describe situations representing the use of perimeter and area; and
   b) use measuring devices to find perimeter in both standard and nonstandard units of measure.
4.11   The student will
   a) estimate and measure length, using actual measuring devices, and describe the results in both metric and U.S. Customary units, including part of an inch (1/2, 1/4, and 1/8), inches, feet, yards, millimeters, centimeters, and meters;

NCTM Standards:

Instructional programs should enable all students to -
Measurement
- explore what happens to measurements of a two-dimensional shape such as its perimeter and area when the shape is changed in some way.
- develop strategies for estimating the perimeters, areas, and volumes of irregular shapes;
- select and apply appropriate standard units and tools to measure length, area…
- develop, understand, and use formulas to find the area of rectangles and related triangles and parallelograms;

Geometry

- identify, compare, and analyze attributes of [two- dimensional] shapes and develop vocabulary to describe the attributes;
- build and draw geometric objects;
- use geometric models to solve problems in other areas of mathematics, such as number and measurement;
- recognize geometric ideas and relationships and apply them to other disciplines and to problems that arise in the classroom or in everyday life.

Unit Objectives

As a result of the unit, the students will *know*

- Perimeter is the distance around a closed figure
- Perimeter is measured with units of length, including metric units and US customary units (inches, centimeters, yards, meters)
- Perimeter of a figure can be found by adding the lengths of the sides
- Area is the size of a two dimensional object; it is the (two dimensional) space inside a region
- Area is measured by units of area, including metric and US customary units (square inches, yards, centimeters, meters)
- The area of a rectangle can be found by multiplying length by width

As a result of the unit, the students will *understand that*

- Perimeter and area are important concepts in daily life as they are widely applied by builders, architects, painters, farmers/gardeners and other designers
- There is a relationship between the perimeter and shape of a rectangle and its area
    - Rectangles of a given perimeter don't necessarily have the same area
    - Rectangles of different shapes can have different areas but the same perimeter
    - The perimeter of a rectangle of a given area can be maximized; the area of a rectangle of a given perimeter can be maximized

As a result of the unit, the students will *be able to*

- Select appropriate tools and units to measure perimeter and area of both physical objects and representations
- Label rectangles with measurements of perimeter and area
- Identify and describe real-life situations in which area and perimeter are usefully applied
- Communicate effectively through drawings, words and numbers
- Work cooperatively in a small group

Instructional Strategies Used

- Brainstorming
- Tiered questioning
- Tiered assignments
- Sternberg's Tri-mind learning preferences
- Interest-based assignments
- Flexible grouping
- Small group and pair collaboration
- Cooperative problem solving
- Learning Contracts
- Anchor activities

Unit Pre-assessment Overview

Before beginning the unit, students will complete two pre-assessment tasks. The first is a writing prompt in their math journals, to draw a picture of perimeter and a picture of area, explaining both in words. At this point in the year, students will have much practice in using drawings and words to explain their mathematical thinking. The drawings and explanations can be examined for evidence of connections to the goals of instruction. Do the students know what the terms (which are also studied in the second grade in VA) mean? Do they use principles of measurement and units in their drawings? Do they show signs of connecting the concepts of area and perimeter? A 3-2-1 exit card at the end of the first lesson will also provide pre-assessment data. The students' drawings of three table configurations will show their comfort with representing area and perimeter, and the question about making another way of seating 32 guests will gauge whether or not students are capable of self-extending what they know about perimeter and area at this point.

In addition to this data, at this time in the year the students' skills with multiplication, which are related to several of the tasks, will already be known. All this data on student readiness can be used to determine the complexity of tasks to be given to each student in the next lessons. Students who show higher levels of existing achievement can be given the more difficult tasks, while students with little memory or understanding of the concepts will be given less complex tasks to begin with.

Sample Differentiated Materials Provided

- Lesson 1 – Readiness-based tiered questioning script
- Lesson 2 – Readiness-based tiered cooperative problem
- Lesson 3 – Readiness-based learning contracts
- Lesson 4 – Interest-based application task
- Lesson 5 – Learning profile-based final task

Unit Overview

Lesson	Whole-class components	Differentiated components
Lesson 1: **Introduction & Literature Connection** *1 class period*	Writing activity as pre-assessment (*10 minutes*) Read-aloud and diagramming of *Spaghetti and Meatballs for All!* (*35 minutes*) 3-2-1 Exit Card (*10 minutes*)	Tiered Questioning script
Lesson 2: **Area and Perimeter using a problem-based approach** *1 class period*	Introduction of tangrams as anchor activity (*5 minutes*) Whole-group sharing for lesson closure (*10 minutes*)	Tangrams can be tiered for readiness Tiered tasks based on readiness (*35 minutes*)
Lesson 3: **Learning Contracts** *2 class periods*	Discussion of definitions and tools for measurement with whole-group brainstorming session of things that have area and perimeter (*10-15 minutes*) Whole-group brainstorming session about uses of area and perimeter in daily life (*5-10 minutes*)	Learning Contract Tasks (*90 minutes*)
Lesson 4: **Interest-based application and practice** *1 class period*	Whole-class sharing of results (*5-10 minutes*)	Self-selected application tasks based on interests (*45 minutes*)
Lesson 5: **Unit assessment** *1-2 class periods*		Self-selected final products based on Sternberg's tri-mind learning profiles (*1-2 class periods, including time to share products*)

Unit Description and Teacher Commentary

LESSON 1 – SPAGHETTI AND MEATBALLS FOR ALL	1 CLASS PERIOD
Lesson Sequence and Description	Teacher Commentary
Pre-assessment: Ask the students to write in their math journals: Draw a picture of "perimeter." Explain your picture in words. Draw a picture of "area." Explain your picture in words. These prompts can be projected for students to work with directly in their math journals. Circulate among the students as they work to informally assess their readiness levels in preparation for tiering questions during the read-aloud. Alternatively, give this pre-assessment any time before this unit begins.	At this point in the year students are mostly comfortable combining writing with drawings and numbers to explain their thinking.
Literature Connection: *Spaghetti and Meatballs for All!* **By Marilyn Burns:** Read the story aloud to the students (whole group). Have an overhead or other technology available and draw the different scenarios of chairs and tables as presented in the book. You will model this activity while using **Tiered Questioning** (see differentiated materials appendix) during the pauses to examine what's happening. The tiered questions are divided into three levels. The first level of questions is less complex and more concrete – the questions can be answered by looking at the figures and counting tables and chairs. The middle tier moves into using the abstract terms 'perimeter' and 'area' instead of asking students to count tables or chairs, and is also more difficult in requiring some comparisons to be made. The highest tier of questions is yet more complex and open-ended, asking students to reason out general rules for the scenario and apply those rules in predictions.	A literature connection typically necessitates a whole-group setting. In order to allow all students to participate in this setting and to continue to experience success, the questioning is pre-written and tiered for achievement level. Students will be matched with appropriate questions.
3-2-1 Exit card: Have students work on the following prompt and drop off their exit cards in the designated location. Draw **3** different ways the tables were set up in the book. Include the chairs. Write the perimeter and area of each table you draw. Write **2** two things you liked or didn't like about the book. Draw **1** other way you could seat 32 guests. You can use as many tables as you want but the same rules about elbow-room apply!	A 3-2-1 exit card allows a check-in about student ability to represent perimeter and area using the chairs/tables method. The second question gathers feedback to inform the next teaching of this unit. The last question requires extension and is similar to the next day's task, providing assessment information for grouping students in lesson 2.

LESSON 2 – TABLES AND CHAIRS PERIMETER TASK, MATH JOURNALS	1 CLASS PERIOD
Lesson Sequence and Description	Teacher Commentary
Introduce the tangrams anchor-activity: Show the students how the tangram shapes can be cut out of a single square. Introduce the tangrams worksheets, which have students create shapes from the tangram pieces and compare their sizes. Show students the folders holding the activities (located in an accessible part of the classroom)	Tangrams are a fun way to work with the concept that area is a way to compare sizes of objects. This anchor activity would be differentiated for readiness by having colored-coded folders with more or less difficult tangram patterns to copy.
Math Journal Problem: Students will work with **Tiered math journal activities**(see differentiated materials appendix), using scenarios based on the tables/chairs problem used in the book from the previous lesson. Students are divided into three groups based on readiness shown in the pre-assessment and exit cards. When working on math journal problems, students know that they may work with a partner, but are responsible for their own recording. The problems are essentially similar, so the task can be introduced to the whole group, and students then work with more- or less-scaffolded journal pages. Materials such as manipulatives and graph paper will be available for use. The problems are tiered based primarily on complexity and open-endedness. The lower tier is fairly directive, students follow the steps as directed and discuss their conclusions. The middle tier task is somewhat more open-ended. It requires students to choose their tables and chairs scenarios themselves and make more open-ended comparisons. The highest tier task pushes students into more abstract, open-ended territory by asking them to seek out optimal solutions to the problem, which may also require more drawings and more calculations (which might bog down less-ready students), depending on the approach taken.	The tiered journal problems help scaffold those who lack skills with measurement or using manipulatives, while posing an interesting challenge for middle and high-readiness students.
Display color-coded (readiness) groups on the board, and tell the students that they may work with a partner from their own color group. Have the students pick up the journal sheets from color-coded folders and begin working.	
Whole class review: Students can share their solution paths for this problem in a whole group setting. Together, the class will likely produce the whole range of possible solutions for this problem. Document the shapes of the tables created on the board and help the whole class generalize a conclusion: which shapes have the most area (given the same perimeter?)	It is helpful for students to hear their peers explain their solution paths. Since students have worked on the same essential task, everyone can contribute to the group discussion. Start with lower-readiness students since they didn't have a choice of which tables to make.

LESSON 3 – LEARNING CONTACT SKILLS PRACTICE	2 CLASS PERIODS
Lesson Sequence and Description	Teacher Commentary
Review of definitions: Present definitions of length, width, perimeter, and area and display examples of each, along with tools used to measure them (rulers and transparent area measurement grids). Refer to environmental print (math posters) with these definitions as well. Brainstorm a list of objects in the room that have perimeter and area.	Area and perimeter are taught in second grade, so this review is brief and serves to help everyone have the vocabulary to work with the story coming up. Also, it makes connections to the real world.
Learning Contracts: Introduce the learning contracts and orient students towards the materials they will need. Each student will have a custom learning contract based on needs and readiness (see **Learning Contract Activities and Example** in the differentiated materials appendix). The tasks range from comparisons of paper cut-outs which will help student grasp the fundamental concept that area is the size of an object, to more complex tasks based on examining area and perimeters when one or the other attribute is fixed.	Learning contracts allow each student to experience multiple activities for their particular needs and readiness. They also allow the teacher to conduct small-group instruction while other students work productively, and provide choice and independence to students.
Whole-group brainstorming session about uses of area and perimeter in daily life: Lead a whole-group brainstorming session to come up with ways that professionals use calculations of perimeter and area in their jobs or daily lives. This is also the time to introduce the choices for the interest-based task tomorrow. Have students put their top two choices on an exit card and drop it off in the usual location.	Having worked with chairs-and-tables scenarios and measured objects around the room, students have exposure to how area and perimeter work in the real world, and can make connections to broader applications of the concepts.

LESSON 4 – APPLICATION TASKS	1 CLASS PERIOD
Lesson Sequence and Description	Teacher Commentary
Self-selected tasks based on interest: Introduce the tasks for today, which are designed to tap into student interest while providing a real-world application of the uses of area and perimeter. These **Interest-based explorations** (see differentiated materials appendix) give students a choice in activities and experience working with a mixed-readiness group. Students have chosen whether to complete the sports facility, school re-decorating, or garden design task. Display the group assignments (of 3-4 mixed-readiness students) on the board, along with the work-space assignments. Have students pick up sets of materials based on their task, plus their order form to buy other needed materials from the store, and assign them to a work space in the room. As they work, each group can use a system of stacked cups (red, yellow, and green) to signal if they need teacher assistance. A green cup on top of the stack indicates that all is well, yellow means a group has a question but can still make progress, and red indicates that the group is stuck and needs teacher assistance to move forward at all. Circulate throughout the room as students work, and distribute materials from the "store" when students have completed order forms. **Whole-group sharing:** Students will share the products of their group tasks. This will allow for a discussion of different ways to approach the problems, which are fundamentally similar. Also discuss what went well while working in groups as an opportunity to reflect on and improve group work effectiveness.	Interest-based groups help students to not feel invalidated by too much readiness-based grouping. Having the students fill out their order forms completely before coming to the teacher-operated store provides plenty of time to circulate among the groups to assist. The first task will hopefully be of interest to students interested in school and/or decorating, the second to students interested in sports, and the last to students interested in gardening or farming. One interesting question to ask here is whether the students bought any extra materials (or too little material). If so, you could ask why this might have been and see if students are having difficulty with measurement or perhaps calculation of perimeter and area.

LESSON 5 – UNIT ASSESSMENT PROJECTS	1-2 CLASS PERIODS
Lesson Sequence and Description	Teacher Commentary
Self-selected assessment tasks based on learning profiles: These tasks ask students to demonstrate their knowledge, skills, and understandings within the context of a learning format appropriate to their own style (see **Learning Profile Final Projects** in the differentiated materials appendix). The first task is designed for students who are comfortable thinking in a practical mode. The second is for students who prefer creative thinking, and the last is designed for analytical thinkers. Describe the tasks to the students and allow them to choose a task to their liking.	The creative task is more open ended; although the task describes conditions for success, careful monitoring of students working on a creative task is called for.

DIFFERENTIATED MATERIALS APPENDIX

DIFFERENTIATED MATERIALS – LESSON 1: Tiered Questioning Script

This script is for a point in the book where 12 guests are trying to seat themselves *together at the same table*. Before this point, six guests were seated around two tables (as in Figure 1). The guests add two more tables, thinking that this will allow six more people to sit (see Figure 2). The next step in the book is Figure 3 – the guests add an additional 2 tables, still trying to seat 12. These questions examine the change from figure one to figure two, and anticipate the change to figure 3.
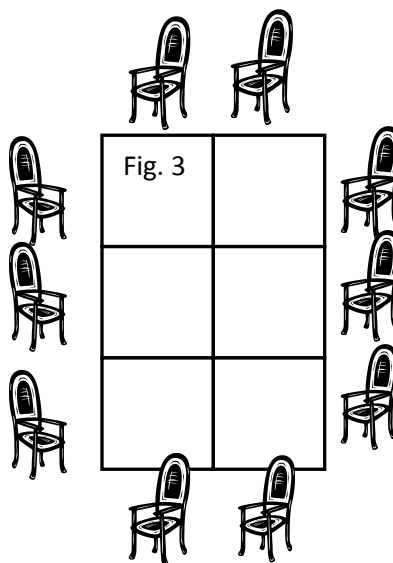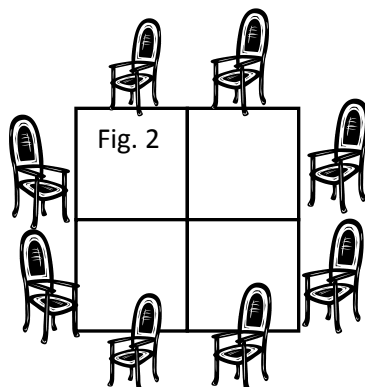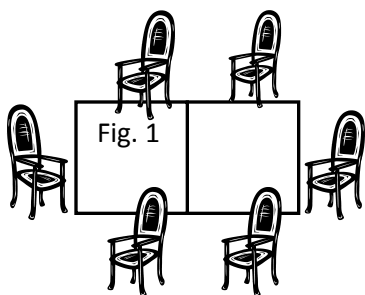
Low-readiness:
How many tables are together now?   How many tables were added?
How many chairs were there before?   How many chairs fit around the table now?
How many seats did they gain?   Do they have enough seats? How many more seats do they still need?

Middle-readiness:
What is the perimeter of this table?
How does the perimeter of this table compare to the perimeter of the previous table?
What is the area of this table?
How does the area of this table compare to the area of the previous table?
How many people can sit at each table now?   How does this compare with the previous table?

Higher-readiness:
Why didn't adding two more tables make it so six more people could sit at the table?
Would it help if they had added the tables to the ends, making a long line instead of a square? Why or why not?
Will adding two more tables (for a total of six tables) solve their problem? Why (or why not)?
Is there any way to add tables and gain more than two seats (while still keeping the shape a rectangle)? Explain.

Fig. 1

Fig. 2

Fig. 3

DIFFERENTIATED MATERIALS – LESSON 2: Tiered Party Planning Math Journal Task

These materials are tiered for readiness. The more difficult task provides much less support for students as they must find optimal solutions to the problem.   The task designed for middle-readiness students reduces the demand by not requiring optimal solutions, but still requires students to think of multiple routes to the same goal of 24 chairs around the table. The task designed for the least-ready students provides additional supports by directing students towards two possible solutions. The students are still responsible for creating the solutions themselves. All students do similar actions – measuring area and perimeter - and they all ultimately work with the same understanding – the relationship between area and perimeter.

Task for Highest-Readiness Group:

You are hosting a picnic at Washington Park. Unlike Mrs. Comfort (from *Spaghetti and Meatballs for All!)*, you know that all your guests want to sit at the *same* table.   Like Mrs. Comfort, you have to rent small square tables to use. Each table costs $10 to rent (the chairs are free).   You have three tasks.

1. Find the *least* expensive way to seat all 24 guests.   Use pictures, numbers and words to prove you're right. Make sure you draw a picture of your table and label the sides, perimeter and area.

2. Next, find the *most* expensive way to seat all 24 guests without having any extra chairs. Use pictures, numbers and words to prove you're right. Make sure you draw a picture of your table and label the sides, perimeter and area.

3. Once you find both, answer these questions on this paper:

   a. How do the perimeters of each table compare?

   b. How do the areas of each table compare?

   c. How does the shape of the table affect the price?

Task for Middle-Readiness Group:

You are hosting a picnic at Washington Park. Unlike Mrs. Comfort (from *Spaghetti and Meatballs for All!)*, you know that all your guests want to sit at the *same* table.   Like Mrs. Comfort, you have to rent small square tables to use. Each table costs $10 to rent (the chairs are free).   You have three tasks.

1. Draw at least three different ways to seat all 24 guests at the same table with no extra chairs.   Use pictures, numbers and words to prove your tables will seat 24 people (no less, no more). Make sure you draw a picture of your table and label the sides, perimeter and area.

2. For each table, calculate how much you will have to pay to rent the tables you will need:

   Table 1: _____   Table 2: _____   Table 3: _____

3. Answer these questions:

   a. Compare the perimeter of your most expensive table and your least expensive table

   b. Compare the area of your most expensive table and your least expensive table

   c. Compare the shapes of your most expensive table and your least expensive table

Task for Lower-Readiness Group:

You are hosting a picnic at Washington Park. Unlike Mrs. Comfort (from *Spaghetti and Meatballs for All!)*, you know that all your friends want to sit at the *same* table.   Like Mrs. Comfort, you have to rent small square tables to use.

1. Use 20 square tiles to make a table that will seat your 24 friends (with no extra seats). Use all of the tiles. Draw your table here:

The perimeter of this table is: _____

The area of this table is: _____

2. Use 32 tiles to make another table that will seat your 24 friends (with no extra seats). Use all of the tiles. Draw your table here:

The perimeter of this table is: _____

The area of this table is: _____

3. Answer these questions:
    a. Each table costs $10 to rent. Which table will cost more to rent? How do you know?
    b. Describe the shape of the more expensive table.
    c. Describe the shape of the less expensive table.

DIFFERENTIATED MATERIALS – LESSON 3: Learning Contract Activities

The activities presents below can be arranged into learning contracts tailored to individual needs. Each activity has a brief description along with a suggestion for each task's use with students of different readiness.   At this point in the unit, assessment data will be available to guide the choice of activities, though all students will need to complete at least some measurement activities to ensure the standards are addressed.   A sample learning contract for a middle-readiness student follows the activity descriptions.

MEASUREMENT:

1. Measurement of rectangular shapes

Description: Students use rulers and transparent area grids to measure pre-cut cardboard rectangles and rectangles printed on paper, recording area and perimeter

Readiness suggestions: Lower-readiness students mostly use rectangles smaller than their measuring tools, and use the pre-cut rectangles. Higher-readiness students measure rectangles larger than their measuring tools and measure rectangles printed on paper

2. Measuring around the room

Description: Students use rulers and transparent area grids to measure physical objects and record area and perimeter.

Readiness suggestions: Lower-readiness students mostly measure objects smaller than their measuring tools, higher-readiness students measure mostly items larger than their measuring tools.

COMPARISONS:

1. Two-piece shapes*

Description: Students fold and cut 6 index cards to make two identical triangles. They rearrange the triangles into different shapes with the rule that only sides of the same lengths can be matched up and must be matched exactly.   Students record the shapes they made and answer questions about the area of the shapes (which is identical for each shape)

Readiness suggestions: Use with lower-readiness students

2. Rectangle Compare with no units*

Description: Students work with pairs of rectangles which are blank except for labels. Pair A: 2x9 and 3x6 rectangle. Pair B: 1x10 and 3x5 rectangle. Pair C: 3x8 and 4x5 rectangle.   They determine which rectangle has greater area or if they are the same size. They may cut for fold the rectangles. They will draw their solution and explain their decision.

Readiness suggestions: Use Pairs A and B with lower-readiness students. Use pairs B and C with middle readiness students (pair C is harder to compare directly)

3. Rectangle Comparison with square units*

Description: Students work with printed pairs of rectangles which are the same or very similar in size. (e.g.: 4x10 and 5x8, 4x6 and 5x5) They use a model or drawing of a square unit, along with a ruler, to determine which

rectangle is larger. They cannot cut out the rectangles but may draw. They will explain their conclusion in words, drawings, and numbers

Readiness suggestions: Students with lower achievement in multiplication can use smaller rectangles to remove some of the burden of calculation.

4. Fill and Compare*

Description: Students work with two rectangles and a blob shape, all similar in size, drawn on a sheet of paper. Students first guess which shape is larger, record their guess, then use a filler (color tiles) to fill in their shape and verify their guess.

Readiness suggestions: Students with lower achievement in multiplication can use smaller rectangles to remove some of the burden of calculation.

EXPLORATIONS & CLARIFICATIONS:

1. Fixed perimeters*

Description: Students work with a loop of string 24 units long. They decide what different-sized rectangles can be made with a perimeter of 24 inches. Students record their rectangles on grid paper, noting the area and perimeter of each shape.

Readiness suggestions: Students with lower achievement in multiplication can use a shorter string (12 units) to remove some of the burden of calculation. Students of higher readiness could forego the manipulative, using only grid paper instead.

2. Fixed Areas*

 Description: Students work with a set of 36 color tiles to make as many different rectangles as possible with the tiles (filled-in rectangles, not just borders). Students record their rectangles on gird paper, recording the perimeter as well.

Readiness suggestions: Students with lower achievement in multiplication can use a smaller set of tiles (12) to remove some of the burden of calculation.

3. Computer Geoboards

Description: Students work with on-line geoboards found at

http://nlvm.usu.edu/en/nav/frames_asid_172_g_2_t_3.html?open=activities&from=category_g_2_t_3.html

This program calculates area and perimeter of the figures made automatically. Students will be instructed to make four figures: a rectangle with area larger than its perimeter, a rectangle with perimeter larger than area, and triangles of the same specifications. They will record the shapes in their math journals.

Readiness suggestions: Students with lower readiness can be given a more scripted exploration. For example "Make a long thin rectangle. What is its area? What is its perimeter? Record your rectangle. Now make a large square. What is its area? What is its perimeter? Record this rectangle. Which shape has a larger perimeter than area? Which shape had a larger area than perimeter?"

4. Computer Fixed perimeters

Description: Students work with a rectangle exploration found at

. This program allows the student to vary the shape of a rectangle with a fixed perimeter and has exploration questions that students can answer in their math journals.

Readiness suggestions: This task is abstract; use with middle- to high-readiness students.

*adapted from *Elementary and Middle School Mathematics: Teaching Developmentally*, 6th Edition. John A. Van De Walle. Pearson Publishing, 2007

Learning Contract Example

Directions: We have studied area and perimeter using the tables-and-chairs method. Now, different students need to practice different skills related to using perimeter and area.   To make sure everyone gets the practice he or she needs, everyone has a Learning Contract to complete over the next two days during math time.

To be successful with your tasks:

- Work hard and concentrate
- If you're confused about directions use the RICE method (Remember, Imagine, Check, Expert Help) before you ask me
- Help your classmates, but don't get behind on your own work
- When you finish part of your contract, put it in the completed math work bin for checking; if the task is not done correctly you can try again.

This is your chance to show you can make plans and manage your own time. Work hard and you will do well!

Contract Tasks for "Dazhiea" [middle-readiness student]:

Comparisons:

- Rectangle Compare with no units – complete pairs B & C

Measurement:

- Measurement of rectangular shapes – measure rectangles D, E, F, G [two pre-cut, two printed on paper. Two large, two small] at the measurement station
- Measuring around the room – measure your desk, the reading table, a floor tile, and the library carpet

Explorations:

- Fixed perimeter activity
- Fixed Area activity

Choice (Pick 1):

- Computer Geoboards
- Computer fixed perimeter
- Fill and Compare

DIFFERENTIATED MATERIALS – LESSON 4: Interest/Choice based exploration

Each of these activities is designed to stretch the student's skills with measuring area and perimeter while engaging in an authentic task of their choosing. By choosing a task suited to their interest, students will hopefully make a stronger connection between the task and the real uses of their growing knowledge – these are all projects which a real builder, decorator or architect might work on. Note that students may generate additional ideas that could be adapted for this task in the brainstorming session throughout the unit. Students should work in groups of three or four on this task. Though students will choose the task they wish to work on, the teacher should orchestrate the groups so that there are mixed levels of readiness, along with an able reader, in each group if possible.

Each group will determine the materials needed for their project and fill out an order form from the "store," which sells the area and perimeter materials.

Materials needed:

Cardboard, glue sticks, tape, scissors, measuring utensils (rulers & transparent area grids), markers, play money, colored papers to represent wall paper, fences, sod, and Astroturf (wall paper patterns and fencing clip art could be printed up, or actual wallpaper or wrapping paper used).

Option 1: Classroom Decorating.

The teacher will supply 4 walls of identical sizes from a cardboard box. Three of the walls will have an opening with a rectangular shape to show a window, door, etc. Each group will be given an order form, and the other materials (scissors, glue, tape, play money) needed to complete their wall.

Student instructions:

Your task is to improve your classroom by covering the walls with wallpaper, and installing a decorative border around the top of the walls of your classroom. First you will need to calculate the area of wallpaper needed for each wall (don't cover up the doors and windows!). Then calculate the length of decorative border needed to go around the top of your wall.

Fill out the order form in your packet, pay the appropriate amount of money, and the shopkeeper (teacher) will fill your order for materials. The shopkeeper won't take your form unless it is completely filled out.

Once you have your wallpaper and border materials, use them to cover your walls and add your decorative border around the top edge of your room.

Sample Order form (order forms for the other tasks are similar):

Champion Wall Coverings, Inc.

Official Order form

Wall 1: Wallpaper needed: _____square inches x $0.02 for each square inch = $_____
Wall 2: Wallpaper needed: _____ square inches x $0.02 for each square inch = $_____
Wall 3: Wallpaper needed: _____ square inches x $0.02 for each square inch = $_____
Wall 4: Wallpaper needed: _____ square inches x $0.02 for each square inch = $_____

   Total Wallpaper needed: _____ square inches x $0.02 for each square inch = $ _____

Total Decorative border needed: _____ inches x $.20 for each inch = $ _____

Grand total all supplies: $ _____ payable by *cash only*.

Option 2: Sports field construction.

The teacher will supply a large flat piece of cardboard. This is the construction site.   Have a pre-drawn large rectangle drawn on the cardboard to represent where the field will be. Also supply smaller pieces labeled "bleachers" (2).   Each group will also be given an order form, and the other materials (scissors, glue, tape, play money) needed to complete their sports center.

Student instructions:

Your task is to create a sports complex.   You must buy and install Astroturf for the sports field, and a fence to go around the property.   Your construction boss wants the rest of the complex (other than the sports field) to be paved in asphalt. Important: No asphalt needs to be poured underneath the bleachers.   Decide where you want to put the bleachers and glue them to your construction site.

You will need to calculate the area of Astroturf needed, the area to be covered by asphalt (remember, your boss wants to save money by not paving under the bleachers), and the lengths of fencing needed to go around your construction site.

Fill out the order form in your packet, pay the appropriate amount of money, and the shopkeeper (teacher) will fill your order for Astroturf, asphalt, and fencing. The shopkeeper won't take your form unless it is completely filled out.

Once you have your materials, use them to build your site!

Option 3: Garden Design.

The teacher will supply a large flat piece of cardboard. This is the garden plot.   Have a pre-drawn long, thin rectangle on the cardboard labeled "garden path." Supply smaller pieces of cardboard labeled "flower bed" and "vegetable bed" (2).   Each group will also be given an order form, and the other materials (scissors, glue, tape, play money) needed to complete their garden.

Student instructions:

Your task is to create a garden for your clients. Your clients want a flower bed and a vegetable bed included in the design, PLUS your clients have already decided where they want a rectangular path that crosses the garden. Everything other than the path and plant beds should be covered with grass. Also, your clients request that you build a fence around the garden for privacy.

Decide where you want to put the flower bed and vegetable bed and glue them to your construction site.

First you will need to calculate the area of gravel needed to cover your path.

Your clients want the rest of the garden to be grass, so calculate the area you'll need to cover with grass so you know how much grass seed to buy. Important: Grass seed is not needed for the flower bed or vegetable bed.

Your clients also want a fence all around the garden site so you'll need to calculate the length of fencing you have to buy.

Fill out the order form in your packet, pay the appropriate amount of money, and the shopkeeper (teacher) will fill your order for gravel, grass seed, and fencing. The shopkeeper won't take your form unless it is completely filled out.

Once you have your materials, use them to build your site!

DIFFERENTIATED MATERIALS – LESSON 5: Learning Profile Final Projects

Students will choose one of the tasks below in order to show the understanding of area and perimeter they have developed over the course of the unit. Each is geared towards one of the learning profiles from Sternberg's tri-mind theory, but all require students to demonstrate their understanding of area and perimeter.

PRACTICAL: Draw plans for your dream house on a 100x100 sheet of graph paper. Each square on the grid will represent 1 foot by 1 foot.

The rules: Each room must be large enough to fit the items typically found inside (for example, a bathroom must be large enough to hold a toilet, sink and bathtub).   Houses must be one story tall only.

Label each room and write the measurements of the rooms on the graph paper. Glue this paper into your math journal.

On the next page in your math journal, make a list of each room in the house you drew (including closets), and list the perimeter and areas of each room.

Each room needs walls to go around the outside edge of the room. Each room must also be outfitted with floor-boards and carpeting. Materials to build the walls cost $10 per foot of wall. Materials for the floor cost $10 per square foot of floor.   How much will it cost to build each room in your house?   Add the price to each room on the list you made.   Examine the largest room in your house and answer the following question: Is there a way to make a room that's the same size, but that would cost less to build? If there is, show how. If there isn't a way to make your largest room any less expensive, prove how you know this.

CREATIVE: Create a product to teach an audience of second graders about perimeter and area. Your must show that you know what each term means, how to find the value of perimeter and area, how they are measured, why each is important to daily life (connection to real world), and demonstrate an understanding of the relationship between perimeter and area.   Your product can be: a song /rap, an illustrated poster for the classroom walls, or a story book about area and perimeter.   Other products are possible with teacher permission

ANALYTICAL: Create two charts.

One chart will show all the possible rectangles you could make with 24 square tiles. Make a drawing of each possibility and document the perimeter of the rectangles. Answer these questions below the chart: when does the rectangle have the largest perimeter? When does it have the smallest perimeter?

The second chart will show all the possible rectangles you could make with a perimeter of 36. You may use a 36 inch perimeter string and one-inch grid paper to help you.   Make a drawing of each possibility and document the area of the rectangles. Answer these questions below the chart: when does the rectangle have the largest area? When does it have the smallest area?