Scaling Shapes

PRE-PLANNING

PRIOR KNOWLEDGE

- How to calculate area and perimeter of an irregular polygon.
- Area is measured in square units and perimeter is measured in linear units.
- Identify similar shapes as having the same shape but possibly a different size. (More advanced: similar shapes have congruent corresponding interior angles and proportional corresponding sides.)
- Identify the scale factor of similar shapes by comparing dimensions.

LEARNING GOALS

- Predict the area and perimeter of shapes that have been scaled by factors of 2 or 3.
- Generalize how the area and perimeter of a shape will change after being scaled by a factor of *s*.

Common Core Standards	Common Core Practices
CCSS.Math.Content.7.G.A.1 Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.	2. Reason abstractly and quantitatively 7. Look for and make use of structure

MATERIALS

- PhET Area Builder simulation: https://phet.colorado.edu/sims/html/area-builder/latest/area-builder_en.html
- Laptop/Chromebook/tablet for each student or pair
- Seating chart that has heterogeneous pairings of students.
- "Scaling Shapes" Activity Sheet for each student (see below)
- Two colors of post-it notes

Amanda McGarry 2/11/15 11:17 AM
Comment [1]: If you only have enough technology for two students to share, it helps to have norms established about sharing technology. Some classes respond well to timers reminding students to switch who is controlling the device, others can rely just on verbal reminders.

Amanda McGarry 2/11/15 11:17 AM
Comment [2]: Pink and blue are being used in the activity sheet below.

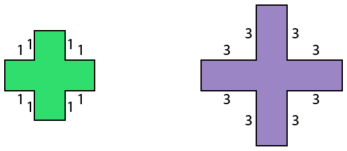
LESSON CYCLE

THINK-PAIR-SHARE — 8 minutes

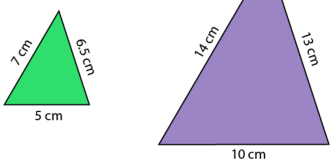
THINK: Activate prior knowledge by having students journal about the following prompt.

Are these two figures similar? Explain how you know. Find the scale factor, if applicable.

1.



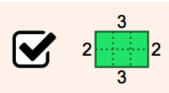
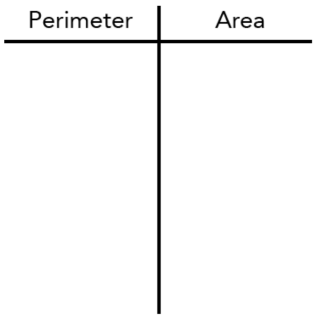
2.



3.

PAIR: Have students discuss their responses with their partner.

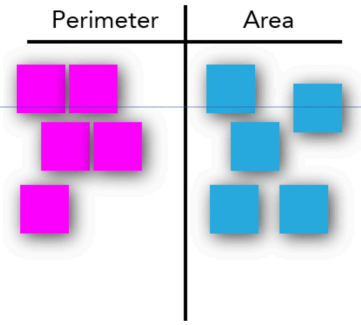
SHARE: Elicit responses from partners to share with the entire class.

INTRO	5 minutes
Teacher will… • Instruct students to open up the sim by going to phet.colorado.edu, click on HTML5 Sims, then click on Area Builder. • Explain that they will play with the Explore screen for 5 minutes before starting the activity. • Ask students to share any tools they uncovered that you think would be useful for the activity- such as the dimensions tool:  • Distribute one activity sheet to each student. • Allow time to read directions independently or call on students to take turns reading aloud.	*Students will use computers and worksheet to…* Explore the first screen of the sim for 5 minutes. Be prepared to share a few things they discovered. Work individually or in partners on a laptop/Chromebook/tablet, discussing the prompts on the worksheet.
GUIDED EXPLORATION	**15 minutes**
Teacher will… • Circulate the room to be available for student questions and to ask probing/pushing questions. If a student is struggling with the task, it can help to probe for more information. 1. How did you come up with your prediction? 2. How will you build your scaled shape? What is your strategy? If they are following the directions perfectly but not naturally making connections, they may benefit from a push. 3. How did you come up with your prediction? 4. Why is #2 limiting the side length to 4 units? 5. Are you surprised at the results for area and perimeter of your scaled shape? What do you think the rule is? 6. What patterns are you noticing? • Divide the front board into two sections:  	*Students will use computers and worksheet to…* Build a shape on their own computer, then trade computers with their partner. Make predictions, then test by building a scaled shape. Compare results. Discuss Part III in groups and write observations about perimeter on the *pink* post-it note and area on the *blue* post-it note. Stick post-it notes on the board.

Amanda McGarry 2/11/15 11:17 AM
Comment [3]: This is an important step that allows students time to feel comfortable with controls in the sim and feel ownership over their exploration.

Amanda McGarry 2/11/15 11:17 AM
Comment [4]: Use whatever strategy already works in your classroom! I like to have a different student read each step aloud while others follow along.

- As partners finish, group them with another partnership to discuss Part III in a group of 4. Have them write their responses on post-it notes and stick them on the front board.



Amanda McGarry 2/11/15 11:17 AM
Comment [5]: Differentiation tip: Ask students to test their observations of patterns to see if they always work with any scale factor (they can use the large board in the sim by clicking the toggle again). Encourage them to try with both simple and complex shapes.

DISCUSSION	15 minutes
Teacher will…	*Students will…*
• Remind students to close their laptops or turn around so that the sim does not distract them from listening.	Put away their device and engage in discussion.
• Use an established teaching strategy such as popcorn discussion (one student answers, calls on the next student to talk), think-pair-share (pose question, allow time to think, turn and talk to partner), or group discussions (print out questions and have groups talk to each other and write down consensus to share aloud with class). Sample questions include:	
1. What is the rule for calculating the *new perimeter* of a scaled shape? **How do you know?**	Justify the scaling rules for perimeter and area.
2. What is the rule for calculating the *new area* of a scaled shape? **How do you know?**	Justify why perimeter and area have different rules when scaling 2D shapes.
3. Why are the rules different for perimeter and area?	
4. Extension: Predict the rule for calculating the *volume* of a scaled cube (or any 3D shape) if you change the side length.	Predict the rule for 3D shapes and justify answer.

SUMMARY	10 minutes
Teacher will…	*Students will…*
• Allow students time to work on application and summary questions in Part IV.	Answer application questions on worksheet while collaborating with their with partner/group.
• Circle the room and listen to conversations about the questions. If you hear good discussions, ask those students to share with the class when you review the summary questions.	
• Elicit responses to summary questions using an established classroom procedure such as writing work on the board, projecting student work under a document camera, or having students compare in groups.	

Name: _____ Class: _____ Date: _____

Scaling Shapes

Objective: Generalize how scale factors affect the area and perimeter of any shape.

Part I. Scale factor of 2

1. **Explore**: Take 5 minutes to explore the Area Builder sim before beginning this worksheet.
2. **Build a Shape**: Click the toggle so that you can view two boards at a time. Build a shape no larger than 4 unit wide or tall, sketch it below, and use the information panel to record the area and perimeter. **Minimize the information panel**.
3. **Predict**: Trade computers with your partner. Ask them to write down their predictions for the area and perimeter of the scaled shape.
4. **Verify**: On the second board, have your partner build a *similar shape* that is scaled by a factor of 2. Sketch it below and maximize the information panel to compare the results with your prediction.

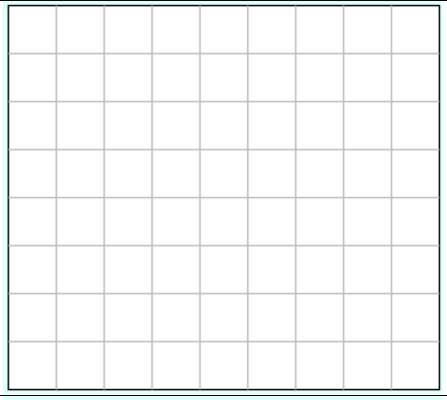
Shape #1		
Original		Area = Perimeter =
Scaled ×2		*Predict…* Area = Perimeter = *Actual* Area = Perimeter =

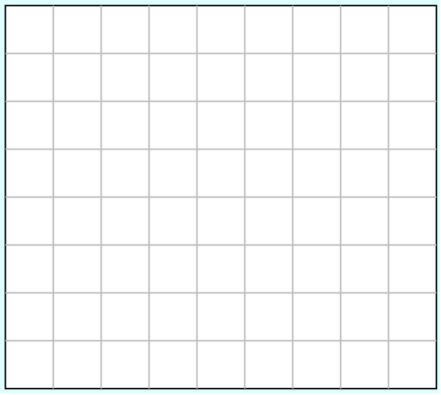
There's more!

Amanda McGarry 2/11/15 11:17 AM
Comment [6]: As students read these directions aloud, keep the sim projected in front of the classroom. Ask student volunteers to come up to the board and demonstrate.

Part II. Scale factor of 3

5. **Build a Shape**: Click the toggle so that you can view two boards at a time. Build a shape no larger than 3 unit wide or 2 units tall, sketch it below, and use the information panel to record the area and perimeter. **Minimize the information panel**.
6. **Predict**: Trade computers with your partner. Ask them to write down their predictions for the area and perimeter of the scaled shape.
7. **Verify**: On the second board, have your partner build a *similar shape* that is scaled by a factor of 3. Sketch it below and maximize the information panel to compare the results with your prediction.

<table>
<tr><td colspan="3">Shape #2</td></tr>
<tr><td>Original</td><td>  </td><td>Area =

Perimeter =</td></tr>
<tr><td rowspan="2">Scaled ×3</td><td rowspan="2">  </td><td>Predict…

Area =

Perimeter =</td></tr>
<tr><td>Actual

Area =

Perimeter =</td></tr>
</table>

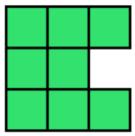
Part III. Group Share

Compare your predictions and actual results for Parts I and II.

- Perimeter: What patterns do you observe between Part I and Part II? What differences do you notice? If you can agree on a rule for how perimeter changes with scaling, write it on a pink post-it note.
- Area: What patterns do you observe between Part I and Part II? What differences do you notice? If you can agree on a rule for how perimeter changes with scaling, write it on a blue post-it note.

Part IV. Apply

8. What are the new area and perimeter of this shape if it is scaled by a factor of 4? Justify your answer.



9. A shape has an original area of 5 and perimeter of 12. What are the new area and perimeter if it has been scaled by a factor of 2.5? Justify your answer.

10. **Generalize**: Explain to someone how to calculate the new area and perimeter of a scaled shape if they know the original area and the scale factor.

11. **Challenge**: A shape has an original area of *a* and a perimeter of *p.* What are the new area and perimeter if it has been scaled by a factor of *s*?