Lesson Summary:
In this lesson, students learn that two figures are similar when the ratios among all corresponding sides are the same. They analyze two figures that are congruent and a figure which appears similar, but is not. They discover the ratio among corresponding sides. Then, students draw similar figures given specific parameters and ratios. Additional activities are suggested to develop deep understanding of similarity.

Estimated Duration: Two - three hours

Commentary:
Students begin to make formal justifications for determining similar figures using ratios. Using an inquiry approach, students can discover what makes figures similar mathematically. Students need the opportunity to look at pairs of figures which are not similar and compare the attributes to develop a deep understanding of similarity. The use of contexts assists students in understanding the ratio when it is used as a scale factor to draw similar figures.

Pre-Assessment:
Informally assess students’ understanding of congruent figures and the concept of congruency.
- Display a transparency of Congruent Shapes, Attachment A, on the overhead projector.
- Ask students to describe the pair of shapes. Responses should include that they are exactly the same or congruent.
- Pair students and have them brainstorm a list or properties of the shape which indicate the shapes are congruent.
- Develop a class list describing the concept of congruency by selecting students to share ideas discussed during brainstorm.

Scoring Guidelines:
Observe students as they discuss the characteristics of the congruent figures. Identify misconceptions students have about congruency and provide intervention as needed. Students should understand that congruent shapes are exactly the same and have side and angle measures that are exactly the same. They may also say the area and perimeter of the shapes are exactly the same.
Identifying and Drawing Similar Figures – Grade Six

Post-Assessment:
This performance is an activity to determine students’ understanding of similar and congruent figures. Use Similar Figures Post-Assessment, Attachment B, to assess the student’s knowledge.
- Give Similar Figures Post-Assessment, Attachment B, to students and a ruler or straight edge.
- Collect and analyze the assessments to determine the need for re-teaching. Discuss misconceptions with the class or with individual students. Return the assessment to students to correct errors.

Scoring Guidelines:
Compare the pre-assessment to the post-assessment to determine if students show understanding of the concepts. Accurate drawings and explanations determine the level of understanding.

Instructional Procedures:
Part One
1. Write the term similar on the board and ask students what the term means to them.
2. Display Investigating Similar Figures, Attachment C, on the overhead projector. Show only the top three shapes. Cover the statement below the three rectangles and the set of triangles. Have the students look at the top three rectangles and ask if they think they are similar. Allow students to discuss with a partner and then select students to share ideas. Record the ideas on the board. Responses may include that all of the shapes are similar because they are all triangles.
3. Reveal the statement, “Rectangles A and B are similar. Rectangle C is not similar to A or B.” Ask students what they think this means. Have them work with a partner and discuss reasons this statement is true. Direct the students to think about the measurements and properties of the rectangles.
4. Select students to share their ideas and record the ideas on the board.
5. Show students the three triangles. Ask them if they think the triangles are similar. Have students discuss with a partner. Select students to share ideas and record the ideas on the board. Responses may indicate that the third triangle is not similar, based on the ideas developed with the first example, that not all rectangles are similar.
6. Reveal the statement, “Triangle A and B are similar. Triangle C is not similar to A and B.” Ask students what they think this means and give them time to discuss the statement with a partner. Focus students on the measurements and properties of triangles.
7. Select students to share ideas and record on the board. Students should begin to see relationships between the measurements of the sides of the shapes.
   - The sides of triangle A are three times longer than the sides of triangle B.
   - Refer to the rectangles and confirm that the sides of rectangle A are twice as long as triangle B.
8. Students may suggest that rectangle C is similar because one is added to both sides. Tell students that similar triangles use ratios. Review ratios with students if necessary.
9. Distribute grid paper to each student and present the following scenario.
   Jenna drafted an announcement for the school carnival which was 8 inches by 12 inches. The principal asked if she could make a poster similar to the announcement using a ratio of 1:3 and a postcard using a ratio of 2:1. Jenna said sure, but wasn’t sure what the ratios meant.
Help Jenna determine the dimensions of the poster and post card. Use what you know about posters and post cards to understand the ratios and draw pictures on the grid paper to support your answers.

10. Have small groups discuss and solve the problem. Assist groups in understanding how to read the ratio and determine if the shape dilates larger or smaller. Students should think that typical posters are larger. In this case the dimensions of the poster are three times longer than the original. When the ratio goes from a smaller to larger number the size of the object grows. Since a postcard is small and the number goes from larger to smaller, students should think that the shapes are smaller. The lengths of the side of the postcard are half the length of the draft version.

11. Provide students with additional problem situations to understand the ratio among corresponding sides and to create and draw similar figures on grid paper.

12. Have students explain similar figures in a journal entry. The explanation should include a discussion of ratios, corresponding sides and illustrations. Collect the journals to informally assess progress.

**Instructional Tips:**
Provide additional activities and support for student understanding of similar figures. Some activities include:

- Purchase king-sized, regular-sized and miniature size of the same candy bar. Have the students measure the dimensions of the bars to determine if the shape of the bars is similar. Have the students determine the ratio among the dimension of the bars.
- Pose the following conjecture
  
  *All regular polygons of one type are similar to each other.*
  *All squares are similar to one another.*
  *All regular hexagons are similar to one another.*
  *All circles are similar to one another.*

  Allow students to use graph paper and attribute blocks to test the conjecture. Students should recognize that all regular polygons of one type and circles are similar.
- Provide ratios that have decimals or fractional parts. For example:
  
  *Mary’s garden is not large enough. She tells the gardener to use a ratio of 1:1.5 to enlarge the garden. The garden is 12 feet by 16 feet. What will the new dimensions be?*
  
  Have students determine the dimensions using the ratio. (18 feet by 24 feet)
- Provide students with pair of similar figures and have students estimate the ratio of figure one to figure two. Make sure ratios go from larger to small figures as well.

**Differentiated Instructional Support:**
Instruction is differentiated according to learner needs, to help all learners either meet the intent of the specified indicator(s) or, if the indicator is already met, to advance beyond the specified indicator(s).

- Give students a basic shape from a template or a pattern block to trace. Use shapes that do not use part of a block on the grid paper.
- Use grid paper with larger squares.
Extensions:
- Collect and distribute comics or small-animated drawings. Have students section the comic/drawing into equal distances horizontally and vertically creating, a grid on the comic or drawing.
- Have students double or triple the small, sectioned drawing onto a piece of grid paper.

Home Connection:
Have students observe objects at home and make a list of objects that are similar to life-size objects. (For example, a dollhouse is a similar to a life-sized house or a toy dinosaur is a scaled model of a life-sized dinosaur.)

Materials and Resources:
The inclusion of a specific resource in any lesson formulated by the Ohio Department of Education should not be interpreted as an endorsement of that particular resource, or any of its contents, by the Ohio Department of Education. The Ohio Department of Education does not endorse any particular resource. Therefore, it may be necessary to search within that site to find the specific information required for a given lesson. Please note that information published on the Internet changes over time, therefore the links provided may no longer contain the specific information related to a given lesson. Teachers are advised to preview all sites before using them with students.

For the teacher: grid paper, tangrams, rulers, pattern blocks, transparency grids, overhead projector, candy bars (optional)

For the students: grid paper, tangrams, rulers or straightedges, pattern blocks, protractors and templates

Vocabulary:
- congruent
- dimensions
- similar

Technology Connections:
- Have students draw basic shapes by free hand, from a drawing program, or by using the shapes that are embedded into word processing software. The shapes can be enlarged reduced, or a copy-cut-paste practice procedure can be applied.
- Use drawing software to create shapes and use ratio aspects of the software to create similar shapes.

Research Connections:

**Attachments:**
Attachment A, *Congruent Shapes*
Attachment B, *Similar Figures Post-Assessment*
Attachment C, *Investigating Similar Figures*
Attachment D, *Grid Paper*
Directions: Make a transparency of the sheet and display on the overhead projector.
1. Two rectangles are shown.

Determine if the shapes are congruent, similar or neither. _____________________________

Explain your reasoning.

2. A right triangle is shown. Draw a triangle that is congruent to the shown triangle and one that is similar on the grid.
3. A parallelogram is shown. Draw a parallelogram that is similar on the grid.

Explain why your parallelogram is similar.

4. A trapezoid is shown. Draw a similar trapezoid using a ratio of 2:1.
5. Draw a rectangle with a length of 6 units and a width of 4 units on the grid. Use a ratio of 1 to 1.5 to make a similar rectangle.
Attachment C
Investigating Similar Figures

Figure A and Figure B are similar. Figure C is not similar to figure A or B.

Figure A and Figure B are similar. Figure C is not similar to figure A or B.