Geometry

Most of the research concerning geometry in the elementary grades focuses on the notion of building understanding in geometry across the grades, from informal to more formal thinking.

Dutch educators Pierre Van Hiele and Dina Van Hiele-Geldof (1959, 1985) suggested that there were five levels of geometric thinking.

Level 0: Visualization: Students recognize and name figures based on their characteristics. This is an intuitive level: It's a square because it looks like a square.

Level 1: Analysis: Students use properties to define classes of shapes: What makes a rectangle a rectangle?

Level 2: Informal Deduction: Students understand the relationship between classes and can make logical arguments about properties: If a figure is a parallelogram, then opposite angles must be congruent.

Level 3: Deduction: This is the usual level for high school geometry, where students work with axioms, theorems, and so on.

Level 4: Rigor: Students evaluate the axioms themselves. This level studies geometry as a branch of mathematical science.

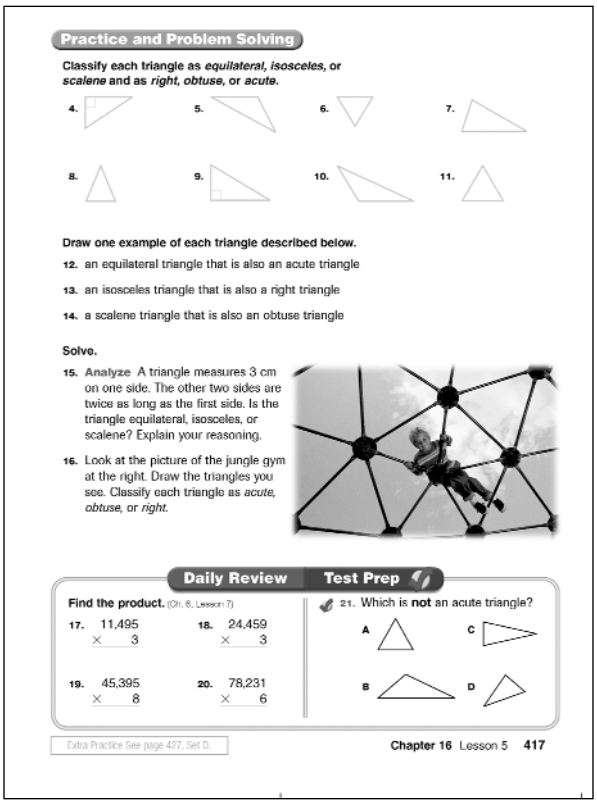
Van de Walle (2001) discusses some characteristics of these levels of thought.

1. The levels are sequential.
2. The levels are not age-dependent in the sense of the developmental stages of Piaget.
3. Geometric experience is the greatest single factor influencing advancement through the levels (Van de Walle, 2001, p. 310).

Other research (Clements and Battista, 1992) points to the idea that the relationship between the levels may be more fluid than was previously thought. In their words, students may regress from the analysis level to the visualization level when confronted with new geometric topics.

Taking all of this research into account, the authors of ***Houghton Mifflin Math*** have developed lessons that include experiences at each of the first three Van Hiele levels of thought.

For example, consider the lesson on classifying triangles in grade 4. First, students are asked to classify a triangle by name (level 0). Then they are asked to draw examples of specific triangles (level 1). Next, they are asked to name a triangle that measures 3 cm on one side with the other 2 sides twice as long (level 2).



Practice and Problem Solving

Classify each triangle as *equilateral, isosceles,* or *scalene* and as *right, obtuse,* or *acute.*

4. 5. 6. 7.

8. 9. 10. 11.

Draw one example of each triangle described below.

12. an equilateral triangle that is also an acute triangle

13. an isosceles triangle that is also a right triangle

14. a scalene triangle that is also an obtuse triangle

Solve.

15. **Analyze** A triangle measures 3 cm on one side. The other two sides are twice as long as the first side. Is the triangle equilateral, isosceles, or scalene? Explain your reasoning.

16. Look at the picture of the jungle gym at the right. Draw the triangles you see. Classify each triangle as *acute, obtuse,* or *right.*

Daily Review **Test Prep**

Find the product. (Ch. 6, Lesson 7)

17. 11,495 × 3 **18.** 24,459 × 3

19. 45,395 × 8 **20.** 78,231 × 6

21. Which is **not** an acute triangle?

A C B D

Extra Practice See page 427, Set D.

Chapter 16 Lesson 5 417

Student Book, grade 4, page 417