Chapter 2 Problem Wrap-Up

Student Text Pages
103

Suggested Timing
45–60 min

Tools
- grid paper
- compasses
- protractor
- ruler
- poster board

Technology Tools
- *The Geometer's Sketchpad*®
- computer
- Cabri® Jr.
- graphing calculator
- Internet access

Related Resources
- G–1 Grid Paper
- G–4 Protractor
- T–4 *The Geometer's Sketchpad*® 3
- T–5 *The Geometer's Sketchpad*® 4
- BLM 2–10 Chapter 2 Problem Wrap-Up Rubric

Using the Chapter Problem

- Review the material on fractals to introduce the problem—the Sierpinski triangle in Section 2.1, question 21; the Koch snowflake in Section 2.2, question 18; and the Making Connections in Section 2.4.
- If you introduced the Chapter Problem earlier, students may have started their research about fractals. If not, allow students the opportunity to begin their research in class.
- Once students start to research fractals, they are faced with an enormous variety of sources—the vast majority of which are inappropriate and/or beyond their level of mathematical understanding.
- This Chapter Problem can be used as a major research performance assessment or as a limited time task.
- Direct students to some appropriate sources, particularly as the question focusses on the content of the chapter (lines, midpoints, and circles). Alternatively, have some students work in small groups to research a specific topic or related series of topics. Go to **www.mcgrawhill.ca/books/principles10** and follow the links to find a list of sources and topics.
- The Chapter Problem is appropriate for pairs or groups of four students.
- Use **T–4 *The Geometer's Sketchpad*® 3** or **T–5 *The Geometer's Sketchpad*® 4** to support this activity.

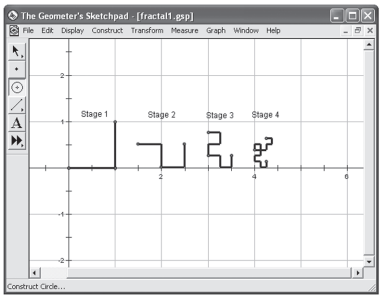
Summative Assessment

- Use **BLM 2–10 Chapter 2 Problem Wrap-Up Rubric** to assess student achievement.

Level 3 Sample Response

a), b) Answers will vary.

A fractal that can be modelled by paper folding is the Jurassic Park Fractal. *The Geometer's Sketchpad*® diagram shows the first four stages of folding a strip of paper. In each stage the paper is folded at the midpoint of the previous fold and folded from right over left. To see the fractal pattern, unfold the paper on its edge and crease all the folds as right angles.



By examining the first four stages I will be able to predict how to find the fifth, sixth, and additional stages. I considered the lengths of the paths and the shape formed by the folds in each stage.

Length:

In each stage the short paths are all the same lengths.

Suppose the length of the paper to be folded is 1 unit. Then, the lengths in the four stages are $\frac{1}{2}$ unit, $\frac{1}{4}$ unit, $\frac{1}{8}$ unit, and $\frac{1}{16}$ unit. The length in the nth stage will be $\frac{1}{2^n}$.

The number of paths in each stage is 2^n. So, the total length of the paths is $\frac{1}{2^n} \times 2^n$, or 1 unit.

Shape:

I looked at right turns and left turns.

Stage	Turns
1	**R**
2	R **R** L
3	R R L **R** R L L
4	R R L R R L L **R** R R L L R L L

I noticed these patterns:

– The middle entry in each list of turns is the first fold, which is a right turn.

– There is a pattern for the number of turns in the stages (1, 3, 7, 15, …). So, the number of turns in the nth stage is $(2^n - 1)$.

– The turns to the left of the middle turn are a repeat of those of the previous stage.

– The turns on the right of the middle turn are the *opposites* of those on the left.

So, stage 5 will be RRLRRLLLRRLLRLL **R** RRLRRLLRRRLLRLL.

c) Answers will vary. Some possibilities are the following:

Astronomy—galaxies, planet rings

Biology—growth of bacteria, plant growth, mammalian anatomy

Chemistry—chemical reactions, molecules

Geography—coastlines and borders, landscapes, ocean currents

Meteorology—clouds, weather patterns

Music

Computing—compressing data

Special Effects

Level 3 Notes

Look for the following:

- Clear understanding of relevant geometric and measurement concepts
- Knowledge of research skills
- Planning and thinking in choosing and analysing a fractal design
- Ability to draw the chosen fractal (with or without technology)
- Ability to apply geometric concepts to the chosen fractal pattern(s)
- Well-constructed mathematical arguments
- Use of good form and correct mathematical notation

What Distinguishes Level 2

At this level, look for the following:

- Some understanding of relevant geometric and measurement concepts
- Some knowledge of research skills
- Some planning and thinking in choosing and analysing a fractal design
- Some ability to draw the chosen fractal (with or without technology)
- Some ability to apply geometric concepts to the chosen fractal pattern(s)
- Some well-constructed mathematical arguments
- Some use of good form and correct mathematical notation

What Distinguishes Level 4

At this level, look for the following:

- Very clear understanding of relevant geometric and measurement concepts
- Detailed knowledge of research skills
- Detailed planning and thinking in choosing and analysing a fractal design
- Detailed ability to draw the chosen fractal (with or without technology)
- Detailed ability to apply geometric concepts to the chosen fractal pattern(s)
- Detailed evidence of well-constructed mathematical arguments
- Use of very good form and correct mathematical notation