

Unit B: Analysis of Games and Numbers

Half Course V

Please see the print document for more activity suggestions. The document is available from the Manitoba Text Book Bureau (stock number 80354). To order, please visit <www.mtbb.mb.ca>.

HALF COURSE V

Unit B: Analysis of Games and Numbers

Hours: 7 in combination with Problem Analysis

General Learning Outcome:

Develop, use, and justify mathematical strategies by analyzing a variety of puzzles and games; develop an awareness of how numbers are used in society.

The material provided for this unit could be used throughout the course to provide a change of pace in a context which is enjoyable yet calls for mathematical and logical thinking.

Specific Learning Outcomes

- B-1 Demonstrate the use of an appropriate strategy in solving puzzles and playing games involving patterns.
- B-2 Explain how numbers are used throughout society to designate, categorize, or order things and events.

ANALYSIS OF GAMES AND NUMBERS

Instructional Strategies

- *Essentials of Mathematics 12*
- See Appendix I for possible activities.
- See Appendix II for additional resources.

**PRESCRIBED LEARNING
OUTCOMES**

SUGGESTIONS FOR INSTRUCTION

General Outcome

Develop, use, and justify mathematical strategies by analyzing a variety of puzzles and games; develop an awareness of how numbers are used in society.

Specific Outcome(s)

B-1 demonstrate the use of an appropriate strategy in solving puzzles and playing games involving patterns

Consider interspersing material from this unit throughout the course; i.e., you may wish to spend a few days on this unit early in the course for motivational reasons and then use the learning activities to provide a break between other units, or in the middle of a long unit.

Devote sufficient time to playing and enjoying a game before analysis begins. Then, allow students to discuss the game and articulate their “winning” strategies. Have students explain why a particular strategy works.

Look at extensions of games and puzzles. What happens if you alter certain rules or the number of players?

Have students explain a strategy in written or oral form to another student so that he or she can use it.

The material in Appendix I is designed to be motivational. It may be used in games, organized tournaments, and the like. Competition should be friendly. Students can compete against the teacher or principal as well as with each other.

Communications	✓ Patterns
Connections	Problem Solving
✓ Number Sense	✓ Reasoning
✓ Organization and Structure	Technology
	✓ Visualization

SUGGESTIONS FOR ASSESSMENT	SUGGESTED LEARNING RESOURCES
<p>Participation and the willingness to accept the challenge of the learning activities are important. Keep a daily record.</p> <p>You may wish to keep anecdotal notes on how students develop their strategies.</p> <p>Recreational activities are an appropriate context for journal writing on both content and attitudinal factors.</p>	<p>Print</p> <p><i>Senior 4 Consumer Mathematics (45S) Part V: A Course for Distance Learning.</i> Winnipeg, MB: Manitoba Education, Training and Youth, 2002. — Cover Assignments</p> <p>Baron, C., et al. <i>Essentials of Mathematics 12.</i> Victoria, BC: British Columbia Ministry of Education, 2003. [ISBN 0-7726-4997-9]</p> <p>Blocksma, Mary. <i>Reading the Numbers: A Survival Guide to the Measurements, Numbers, and Sizes Encountered in Everyday Life.</i> Penguin Books, 1989. [ISBN 0-14-01.0654-5]</p> <p>Hopkins, N.J., J.W. Mayne, and J.R. Hudson. <i>The Numbers You Need.</i> Detroit, MI: Gale Research, Inc., 1992. [ISBN 0-8103-8373-X]</p> <p>Muschla, G.R., and J.A. Muschla. <i>Hands-On Math Projects with Real-Life Applications.</i> West Nyack, NY: The Center for Applied Research in Education, 1996. [ISBN 0-87628-384-9]</p> <p>National Council of Teachers of Mathematics. <i>Historical Topics for the Mathematics Classroom.</i> Reston, VA: NCTM, 1989, 1969. [ISBN 0-87353-281-3]</p>

**PRESCRIBED LEARNING
OUTCOMES**

B-2 explain how numbers are used throughout society to designate, categorize, or order things and events

SUGGESTIONS FOR INSTRUCTION

Present topics showing how numbers are used in society and have students discuss the use of numbers. Or, assign various topics to individual students or small groups and have them present how the numbers are used.

Topics might include:

- bar codes
- barometric pressure
- body fat
- body mass index
- cholesterol
- comfort index (weather)
- consumer price index
- earthquakes
- firewood
- gasoline
- gross domestic product
- insulation
- knitting needles
- tide tables
- wire

Communications	✓ Patterns
Connections	Problem Solving
✓ Number Sense	✓ Reasoning
✓ Organization and Structure	Technology
	✓ Visualization

SUGGESTIONS FOR ASSESSMENT

SUGGESTED LEARNING
RESOURCES

Print (continued)

Posamentier, A.S., and J. Stepelman. *Teaching Secondary School Mathematics: Techniques and Enrichment Units*. Toronto, ON: Merrill, 1990.
[ISBN 0-675-21209-X]

Problems for High School Mathematics: Support Document. Winnipeg, MB: Manitoba Education and Training, 1994.
[ISBN 0-7711-1208-4]

Reimer, W., and L. Reimer. *Historical Connections in Mathematics*. Fresno, CA: AIMS Educational Foundation, 1992.
[ISBN 1-881431-35-5]

Sutcliffe, Andrea. *Numbers: How Many, How Long, How Far, How Much . . . All the Numbers You'll Ever Need*. A Stonesong Press Book, Harper Perennial, 1996.
[ISBN 0-06-273362-1]

Note 1: Many bookstores carry problem and puzzle books.

Note 2: *Mathematics Teacher and Mathematics Teaching in the Middle School* from the National Council of Teachers of Mathematics have useful articles and activities.

Appendix I

Teacher Information: Balancing Act

Skills Required

- number sense
- problem solving
- reasoning
- visualization
- organization

When to Use

This activity can be used at any time.

Teaching Suggestions

Use the clues given to divide the diagram by the left and right side. Each side has to equal a half of 92.

Solution

If the total mass is 92, then each arm of the balance equals 46. The right arm of the balance is split into two, which means each arm is 23. The rectangles are larger than the circle (the given clue). If the rectangles are 11, the circle is 1, and the diamond is 10. If the diamond is 10, the triangles are not whole numbers ($13 \div 2$ is not a whole number). So, the rectangles cannot be 11. (**Note:** We can conclude that the rectangles must be even.)

If the rectangles are 10, the circle is 3, and the diamond is 7. If the diamond is 7, the triangles are 8. On the left arm, the rectangle is 10, which leaves 36 to be split equally on the hanging arms. Each side is 18, which makes the stars 9. The triangle is 8 which makes the pentagons 5. The solution works.

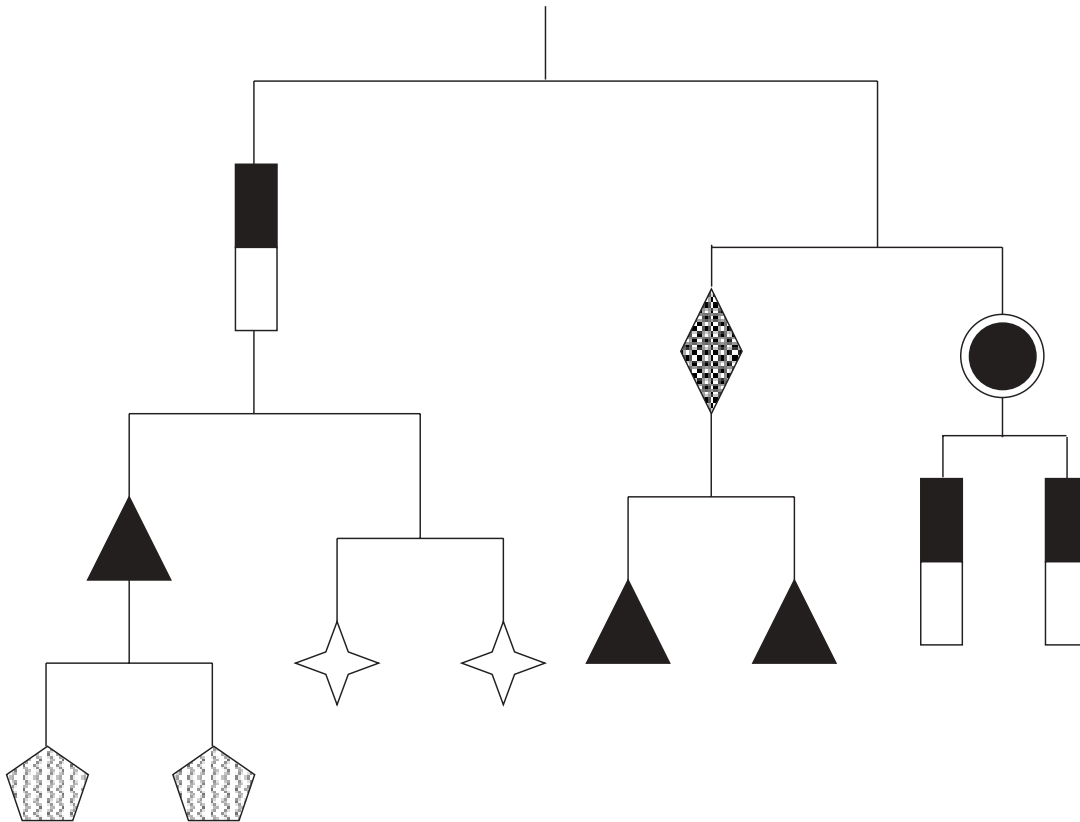
If the rectangles are 8, the circle is 7, and the diamond is 1. If the diamond is 1, the triangles are 11. On the left arm, the rectangle is 8, which leaves 38 to be split equally on the hanging arms. Each side is 19 and that means the stars are not whole numbers. Therefore, the solution where the rectangles are 10 is the only solution. (If the rectangles are 6, the circle is 11, and that contradicts the clue.)

Extension

Have students design their own. Students can then share their problems and solve.




Blackline Master: Balancing Act

The following diagram represents a hanging balance. Each shape has a unique whole number mass. Identical shapes have the same mass.



Determine the value or mass for each shape. Use reasoning and the following clues to help you solve the problem.

1. The total mass is 92 units.

2.  —  = 

Teacher Information: Horseshoe

Skills Required

- pattern recognition
- visualization

Materials

- gameboard
- 6 markers; 3 of one colour, 3 of another colour

When to Use

This activity can be used at any time.

Teaching Suggestions

This is an extension of the “Ko-ko” game found in *Essentials of Mathematics 12*. Ask students to write a strategy for winning Horseshoe.

Extension

Have students make up their own blockade game with written rules so that others may play the game without asking for help.

Blackline Master: Horseshoe

Players: Two

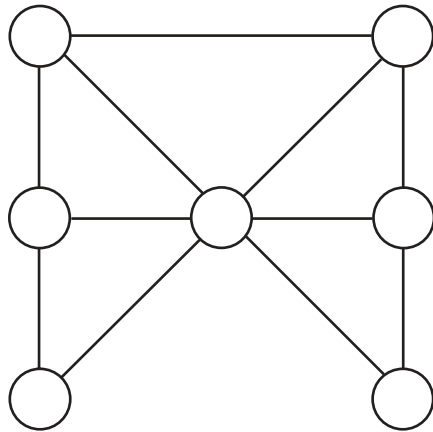
Game pieces: The game board

Six markers: three yellow and three red

Objective: To block your opponent from being able to move

Rules:

- Take turns placing markers one by one on empty circles on the board.
- After all markers have been placed, players take turns moving one marker at a time along the lines of the playing surface to the next empty space. No jumping or capturing is allowed.
- A player wins when his or her opponent cannot move.



Teacher Information: Number Fun

Skills Required

- number sense
- organization

When to Use

This activity can be done at any time.

Teaching Notes

- The number trick is straightforward. Encourage students to develop similar tricks of their own.
- For *Swat Team*, the answers will vary depending on what assumptions are made. For example, are there sufficient flies for folks to keep swatting? What other assumptions might one make?
- For *Addition*, each letter represents a different one-digit number. Here is a solution:

$$\begin{array}{r} 95.67 \\ \underline{10.85} \\ 106.52 \end{array}$$

Is this solution unique?

Blackline Master: Number Fun

Trick

1. Choose any number.
2. Add the next larger number.
3. Add 7.
4. Divide by 2.
5. Subtract your original number.

Do this with five different numbers. Show why you get the same result in every case.

Swat Team

If 10 people swat 10 flies in 10 minutes, how many flies can 20 people swat in 20 minutes?

Addition

A student goes off to university but soon runs out of money. He sends the following telegram to his parents:

$$\begin{array}{r} \text{S E . N D} \\ \text{M O . R E} \\ \hline \text{M O N . E Y} \end{array}$$

How do his parents know how much money to send? Is your answer unique?

Teacher Information: Map Colouring

Skills Required

- spatial visualization

When to Use

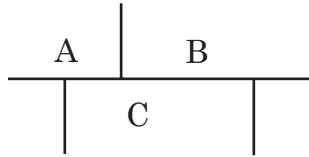
This activity can be done at any time.

Teaching Notes

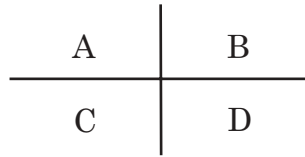
The maps can be used for students to practise the map-colouring problem.

Blackline Master: Map Colouring

The map below shows several different countries. Each country is to be coloured so that the areas are easy to see. If two countries share a common border, then the two countries must be coloured differently.

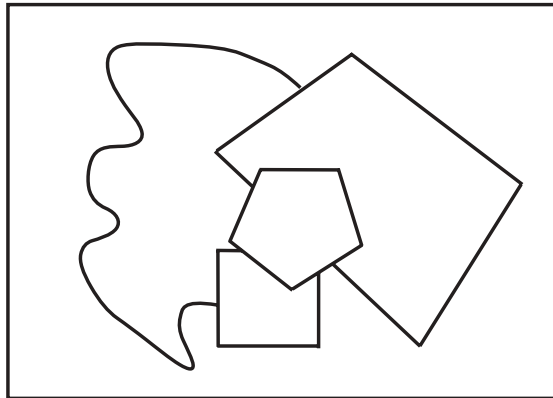


three colours needed



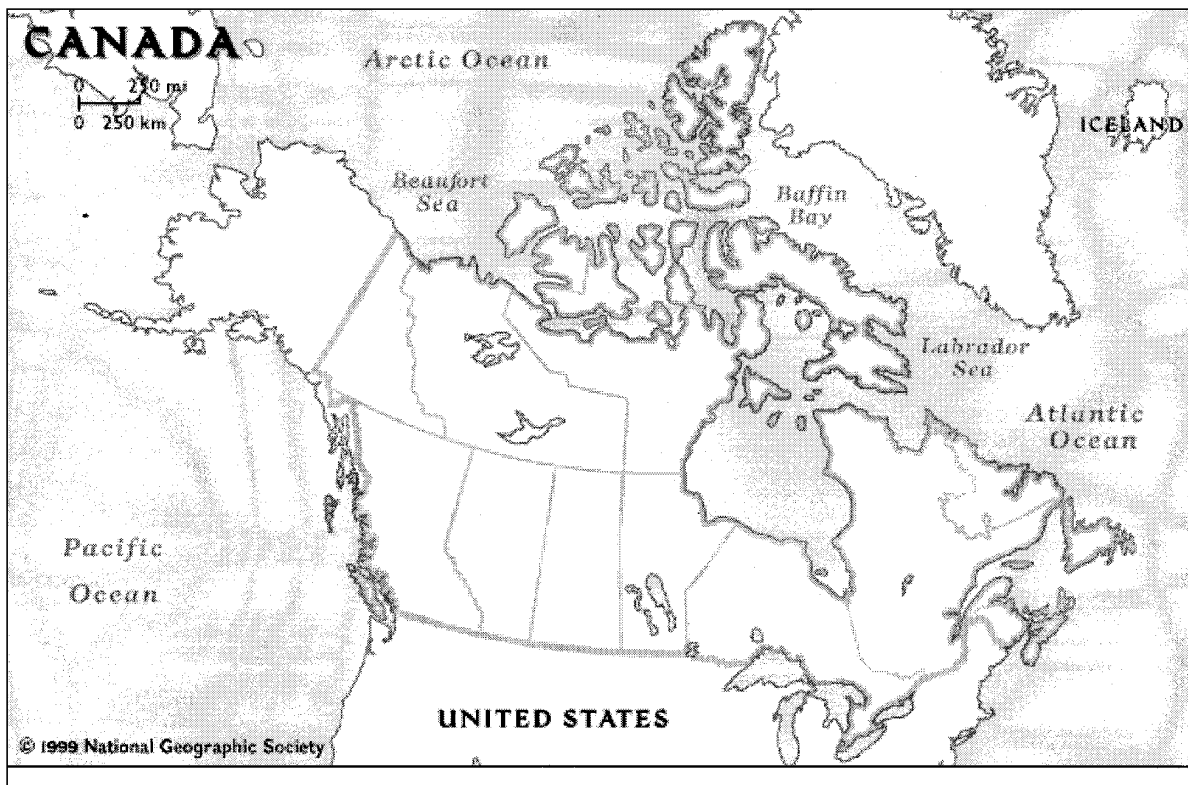
A and D one colour
B and C second colour

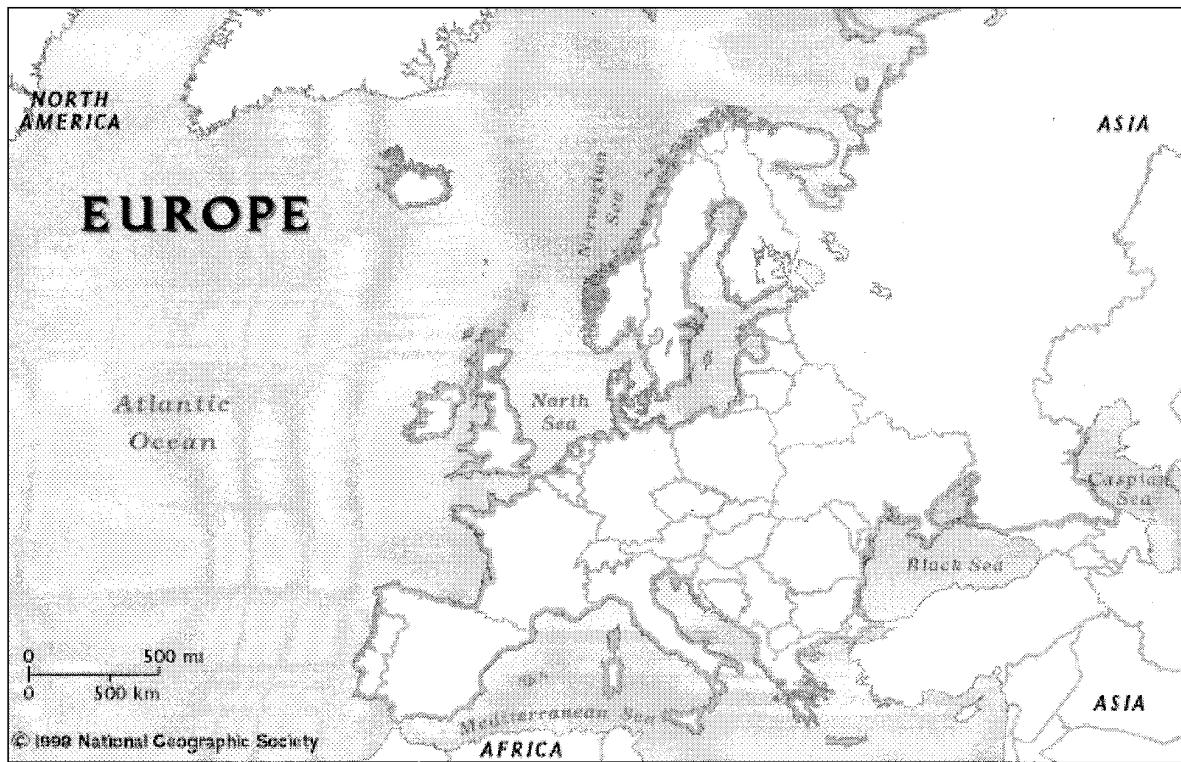
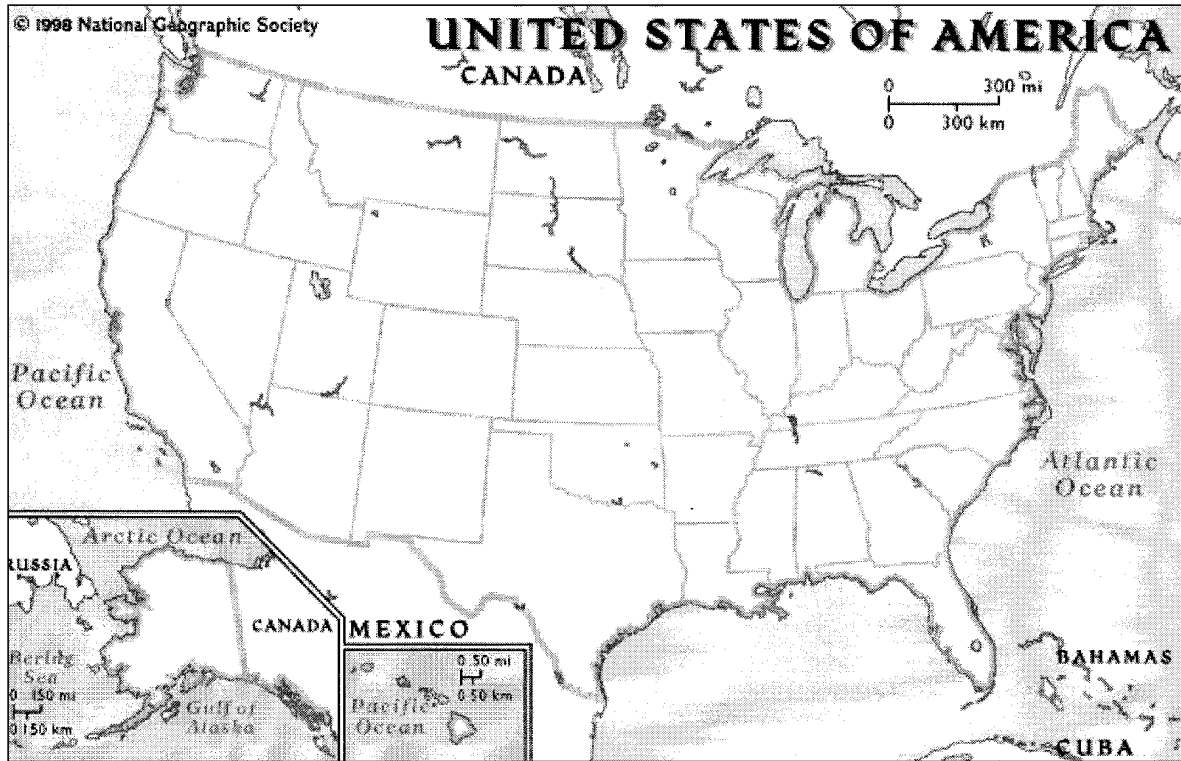
Code the map below for colouring. Use the minimum number of colours.

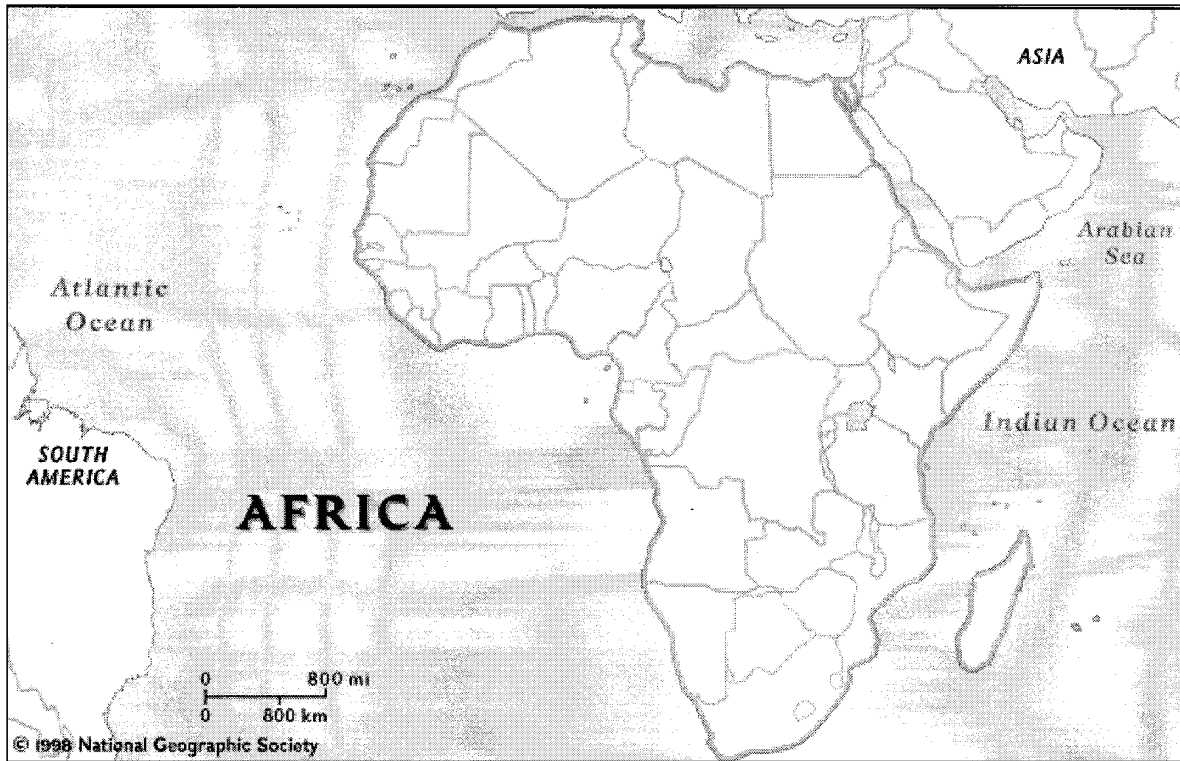


The colouring of maps is a longstanding problem in mathematics. It was recognized long ago, and proven mathematically, that any map could be coloured with five colours. It was hypothesized that, in fact, only four colours are needed. No one was able to find or generate a map which required more than four colours, but at the same time it was not proven that such a map could not exist. Finally in the 1980s, a mathematician claimed to have proven that any map may be coloured with no more than four colours.

See if you can colour the maps on the following pages using only four colours.







Appendix II

Additional Resources

Print

Blocksma, Mary. *Necessary Numbers: An Everyday Guide to Sizes, Measures, and More*. San Diego, CA: Portable Press, 2002. ISBN 1-57145-866-2.

The Diagram Group. *The Little Giant Encyclopedia of Games for 1 or 2*. Sterling Publishing Company Inc. ISBN 0-8069-0981-1.

Fleisher, Paul. *Brain Food: Games That Make Kids Think*. Zephyr Press. ISBN 1-56976-072-1.

Kroner, Lou. *In the Balance: Algebra Logic Puzzles*. Creative Publications. Grades 4–6: ISBN 0-7622-0551-2
Grades 7–9: ISBN 0-7622-0552-0

Note: The Grades 4–6 book has some tough puzzles and is not necessarily just for Grades 4–6.

Nasht, Helen, and Dorothy Masterson. *Humorous Cryptograms*. Sterling Publishing Company Inc. ISBN 0-8069-3982-6.

Tuller, Dave, and Michael Rios. *Mensa Math and Logic Puzzles*. Sterling Publishing Company Inc. ISBN 0-8069-4199-5.

Internet

There are many sites on the Internet with problems and puzzles. When searching for problems and puzzles, use the words “mathematical games.”

As of February 2004, the following sites were available:

Fun Brain

<<http://www.funbrain.com>>

This site offers some interactive games. Some of the games could be adapted to pencil-and-paper games.

Puzzlemaker

<<http://www.puzzlemaker.com>>

This site allows teachers to create their own puzzles. One of the puzzle types is cryptograms. When using the site, be sure to print the answer with the puzzle as all puzzles are created new with each visit.

This Is Mega Mathematics

<<http://www.c3.lanl.gov/mega-math/>>

There are a variety of activities here. One of the activities involves map colouring. Another activity involves games with graphs.