

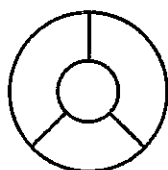
LESSON 13

From **Math Trek: Adventures in the Math Zone** (informational)
by Ivars Peterson and Nancy Henderson

It has taken more than a hundred years for mathematicians to prove that four colors are always enough to complete every conceivable map that can be drawn on a flat piece of paper, with no neighboring territories sharing the same color.

The problem was first **posed** in a letter that Francis Guthrie, a student in England, wrote to his younger brother, Frederic, in 1852. Frederic, in turn, described the problem to his college math instructor, the **prominent** British mathematician Augustus De Morgan. The problem **intrigued** De Morgan, and he quickly realized that it wasn't as simple to solve as it sounded. Word of the four-color-map problem spread quickly.

Another English mathematician, Charles Lutwidge Dodgson, worked on the four-color-map problem. Dodgson figured out that four colors would be needed for the type of map shown below, which **resembles** . . . the area around Luxembourg on a map of western Europe



Four colors are always needed for a map in which three regions surround a fourth area.

In 1879, Alfred Bray Kempe, a British lawyer and **amateur** mathematician, announced that he had found a step-by-step map-coloring procedure **guaranteeing** that no more than four colors would be needed for any map. His argument was

convincing, but 11 years later, someone found a loophole. There were a few, special, complicated cases that Kempe's **method** did not cover.

Finally, in 1976, two math professors at the University of Illinois, Kenneth Appel and Wolfgang Haken, came up with a proof of the four-color-map theorem. One of the biggest problems in mathematics had finally been solved! Mathematicians around the world cheered and celebrated.

Anyone who tried to study the proof was in for a shock, however. It was one of the longest mathematical proofs that anyone had ever come up with. The writing and diagrams filled hundreds of pages. It was the first time mathematicians had ever relied on a computer to calculate and **verify** certain facts needed for their proof.

The computer allowed Appel and Haken to analyze a huge number of possible types of maps. If anyone had tried to do the job by hand, it would have taken almost forever.

Even now, some mathematicians still wonder whether there might be a tiny error in the proof. The complex computer software could have been faulty, or the method of mathematical reasoning could have been **flawed**. The general **consensus**, however, is that the proof is probably correct.

Someday, someone may find a shorter proof, but it's possible that there really is no easier way to prove the four-color-map theorem. Sometimes a short, simple mathematical idea calls for an incredibly complicated proof.

Exercise I: Context Clues

Read the passage above, paying special attention to the words in dark type. These are the Master Words you will study in this lesson. As you read, look for context clues in the sentences and paragraphs around each Master Word. Circle any words and phrases that give clues to the meaning of the Master Words.

Master Words

Place a check by words you feel you know; underline words you don't know.

amateur

flawed

intrigue

pose

resemble

consensus

guarantee

method

prominent

verify

Exercise 2: Using Context Clues

Fill in the form for each of the Master Words listed below with context clues (if any), your definition, and the dictionary definition. If you have difficulty writing a definition, try using the word in a sentence instead.

1. **amateur** Part of Speech: *adj.* Context Clues: _____

Your Definition: _____

Dictionary Definition: _____

2. **consensus** Part of Speech: *n.* Context Clues: _____

Your Definition: _____

Dictionary Definition: _____

3. **flawed** Part of Speech: *adj.* Context Clues: _____

Your Definition: _____

Dictionary Definition: _____

4. **guarantee** Part of Speech: *v.* Context Clues: _____

Your Definition: _____

Dictionary Definition: _____

5. **intrigue** Part of Speech: *v.* Context Clues: _____

Your Definition: _____

Dictionary Definition: _____

6. **method** Part of Speech: *n.* Context Clues: _____

Your Definition: _____

Dictionary Definition: _____

7. **pose** Part of Speech: *v.* Context Clues: _____

Your Definition: _____

Dictionary Definition: _____

8. **prominent** Part of Speech: *adj.* Context Clues: _____

Your Definition: _____

Dictionary Definition: _____

9. **resemble** Part of Speech: *v.* Context Clues: _____

Your Definition: _____

Dictionary Definition: _____

10. **verify** Part of Speech: *v.* Context Clues: _____

Your Definition: _____

Dictionary Definition: _____

• • • Exercise 3: Using Words in Context

Correct or Incorrect: Write **C** on the line if the statement is correct; write **I** if the statement is incorrect.

- _____ 1. A trustworthy company will **guarantee** its products and replace faulty items.
- _____ 2. A **prominent** actor is rarely well known.
- _____ 3. Whenever possible, you should buy **flawed** products because they are so sturdy.
- _____ 4. As an **amateur**, the guitarist volunteered his time and talent.
- _____ 5. An interesting case will **intrigue** an eager detective.
- _____ 6. When a group reaches **consensus**, it is too sharply divided to continue discussion.
- _____ 7. Solving complicated problems is easier when you use a proven **method**.
- _____ 8. In a democracy, citizens can **pose** suggestions for new laws.
- _____ 9. Journalists usually do not **verify** the facts of the stories they report.
- _____ 10. Coyotes **resemble** wolves but they are usually smaller.

• • • Exercise 4: Sentence Completion

From the Master Words, choose the appropriate word for the blank in each of the following sentences. Write the word in the space provided at the right.

1. At the end of the speech, a listener ...?...(d, ed) a fascinating question.
2. The chef had a unique ...?... for poaching eggs.
3. Isabel's science experiment was ...?... because she forgot to account for the change in temperature.
4. Brothers and sisters are very likely to ...?... one another.
5. Web sites secure personal information by requiring users to ...?... their identity.
6. The college hired a ...?... football coach with a well-known record of winning seasons.
7. The toy train rumbling around the tracks ...?...(d, ed) the puppy, who couldn't take its eyes off of the toy.
8. The antique dealer ...?...(d, ed) that the chair was really 200 years old.
9. The ...?... of the club members was to use their dues for new equipment.
10. The ...?... singers put on an outstanding talent show.

Exercise 5: Related Words and Meanings

The italic words in the sentences below are synonyms of the Master Words. Write the matching Master Word from the list on the line following the sentence.

intrigue

prominent

guaranteed

method

verify

- The *noted* author of children's books was interviewed on television about how she gets her ideas for stories.
- The unfamiliar object in the sky *interested* the curious astronomer.
- The witness will *testify* that the blue car did not have lights.
- Tilly *promised* she would get her homework done before going out.
- What *strategy* do you use for doing long division.

Exercise 6: Analogies

Determine the relationship between the first pair of words below. Then write the Master Word on the blank that would create a similar relationship with the second pair of words. The types of analogies used are synonyms, antonyms, action/receiver of action, and actor/action. (See page 158 for a guide to analogy types.)

- | | | | | | | |
|--------------|---|------------|----|--------------|---|------------|
| 1. cry | : | laugh | :: | deny | : | _____ |
| 2. sing | : | song | :: | _____ | : | suggestion |
| 3. shy | : | outgoing | :: | unremarkable | : | _____ |
| 4. ideal | : | real | :: | perfect | : | _____ |
| 5. strangers | : | differ | :: | brothers | : | _____ |
| 6. expert | : | hobbyist | :: | professional | : | _____ |
| 7. wish | : | hope | :: | _____ | : | pledge |
| 8. criticism | : | compliment | :: | conflict | : | _____ |
| 9. recipe | : | formula | :: | technique | : | _____ |
| 10. hungry | : | full | :: | _____ | : | bore |

Write About It: History of a Breakthrough

Using online sources, research mathematical breakthroughs or inventions. Select one that interests you and **write a brief history** of how it came about. Use at least five Master Words or words related to the Master Words in your account.