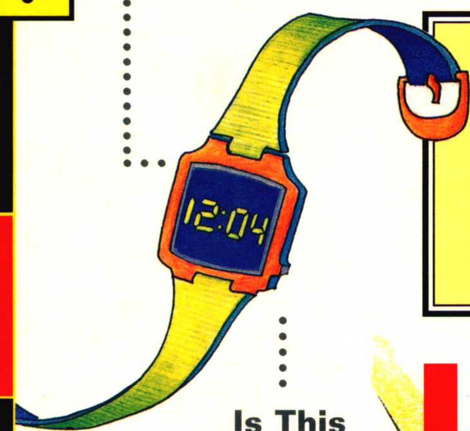
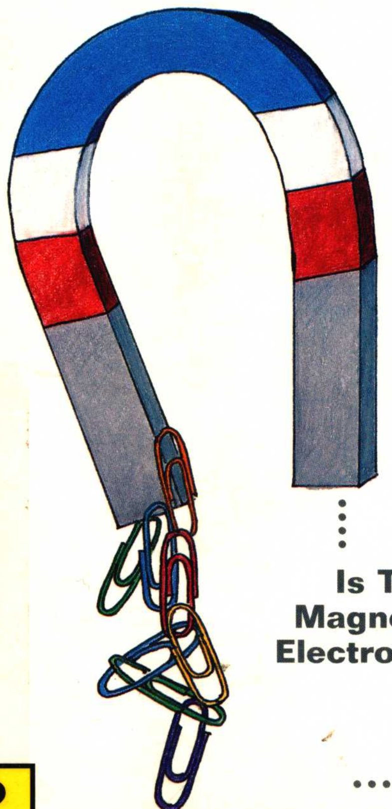
WHAT'S THE DIFFERENCE BETWEEN

Lenses and Prisms and Other Scientific Things?

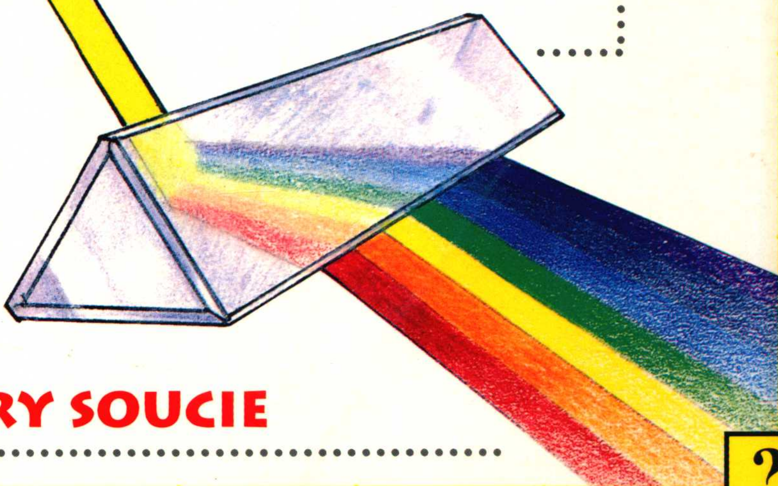


Is This Analog or Digital?

Is This Incandescent or Fluorescent?



Is This a Magnet or an Electromagnet?



Is This a Lens or a Prism?

GARY SOUCIE

What's the difference between . . .

Lenses and Prisms and Other Scientific Things?

Gary Soucie

Illustrated by Jeff Domm

John Wiley & Sons, Inc.

New York • Chichester • Brisbane • Toronto • Singapore

This one's for
Nick and Vladik

This text is printed on acid-free paper.

Library of Congress Cataloging-in-Publication Data
Soucie, Gary.
What's the difference between lenses and prisms and other scientific things? / Gary Soucie: illustrated by Jeff Domm.
Includes index.
ISBN 0-471-08626-6 (alk. paper)
1. Science—Miscellanea—Juvenile literature. 2. Technology—Miscellanea—Juvenile literature. 3. Children's questions and answers. [1. Science—Miscellanea. 2. Technology—Miscellanea. 3. Questions and answers.
I. Domm. Jeff. 1958–
Q163.S715 1995
500—dc20 95-10235
AC

Printed in the United States of America

10 9 8 7 6 5 4 3 2 1

About This Book

This book looks at the differences between lots of things in the world of science and technology that many people tend to confuse. Sometimes the differences between things are small, and easily overlooked, but every distinction is important to scientists.

It may surprise you to learn that these distinctions are not always simple or neat. Scientists may know a lot about how things work or how to use them, and still not know for sure exactly what they are. That uncertainty is part of what makes science so fascinating.

How This Book Works

The book is divided into two sections. The first answers questions about the so-called "hard sciences"—chemistry and physics—plus a little mathematics. The second covers technology.

As an example of how each entry is set up, let's begin with this question:

What's the difference between . . .
Science and Technology?

Science is the study of things in nature and the universe, and the knowledge that this study produces. Technology is the use of scientific knowledge to serve society and people.

Science is based on searching for facts through careful observation and orderly experimentation. Sometimes, theories, laws, and other conclusions may be drawn from the scientific evidence. Science isn't in the facts themselves, but in the way the facts are determined and how the facts are used.

Technology is a marriage of knowledge and know-how. It applies the knowledge of science and the know-how of **engineering** to industrial processes. Science seeks to answer basic questions and technology tries to solve practical problems. Something called "applied science" falls sort of in between. It's the study of how to put science to practical use, how to *do* things.

During the eighteenth and early nineteenth centuries, many scientists—including Benjamin Franklin, Charles-Augustin de Coulomb, Alessandro Volta, André-Marie Ampère, and Michael Faraday—conducted important experiments that told them many things about electricity and how it works. That was science.

When Thomas Edison invented the first electric lightbulb in 1879, that was applied science. Soon thereafter, Edison, Nikola Tesla, and others developed ways to generate and distribute large amounts of electricity to lightbulbs, run motors, and do other useful **work**. That was technology.

> *Did you know?*
>
> - Sometimes technological gadgets were developed before the science behind them was known. Here's an example: Hero of Alexandria, who lived in Egypt during the first century B.C., took a metal sphere with two faucetlike vents attached and filled it with water. The sphere was then suspended over a fire between two brackets. When the water in the sphere boiled, steam escaped from the vents, causing the sphere to spin. It wasn't much of a scientific advancement, because Hero never developed a hypothesis or theory about what was happening. Nor could it be called a technological development, because no one knew what it was good for. So the world's first steam turbine and jet engine was just an amusing toy.

Okay, now you know how it works.

You might have noticed that a few words in this book—such as **engineering** and **work** in our example—are printed in **boldface**. Just in case you don't know these words, they are defined in a glossary at the end of the book. Using this book is easier than going to a dictionary or encyclopedia, but you should refer to them often whenever you are wondering about science and technology.

You can read this book from cover to cover, dip into it at random, or look up specific things you want to know about. You can also use it as a game to play with family and friends. Just read the questions aloud and see whether anyone knows the answers. And don't forget the *Did you know?* questions.

If you want to keep score, award points for correct answers. A straightforward question that has a single answer could be worth one, five, ten, or however many points you want to use. If the answer is a list of things, you can award a single point for each correct response.

If you have a lot of people in the game, you might divide them into teams of two, three, or four and let them compete for points. You can ask questions of each player (or team) in turn, or you can throw the question out and let the player who first raises a hand, rings a bell, or shouts, "I know!" have the first shot at it. You've watched game shows on television. You know the different ways to do it.

However you decide to use this book, I hope you learn a lot of neat things and have a lot of fun. I did while writing it.

Contents

Technology 45

Science

What's the difference between . . .

Theories and Hypotheses?

A hypothesis is the unproven, but logical, idea being tested in a scientific experiment or investigation. A theory is a general principle or set of principles that explains specific facts or events of the natural world.

A theory is assumed to be true because it is based on other phenomena that are proven or generally thought to be true. (Einstein's theory of **relativity** is a famous

HYPOTHESIS =
An idea being tested.

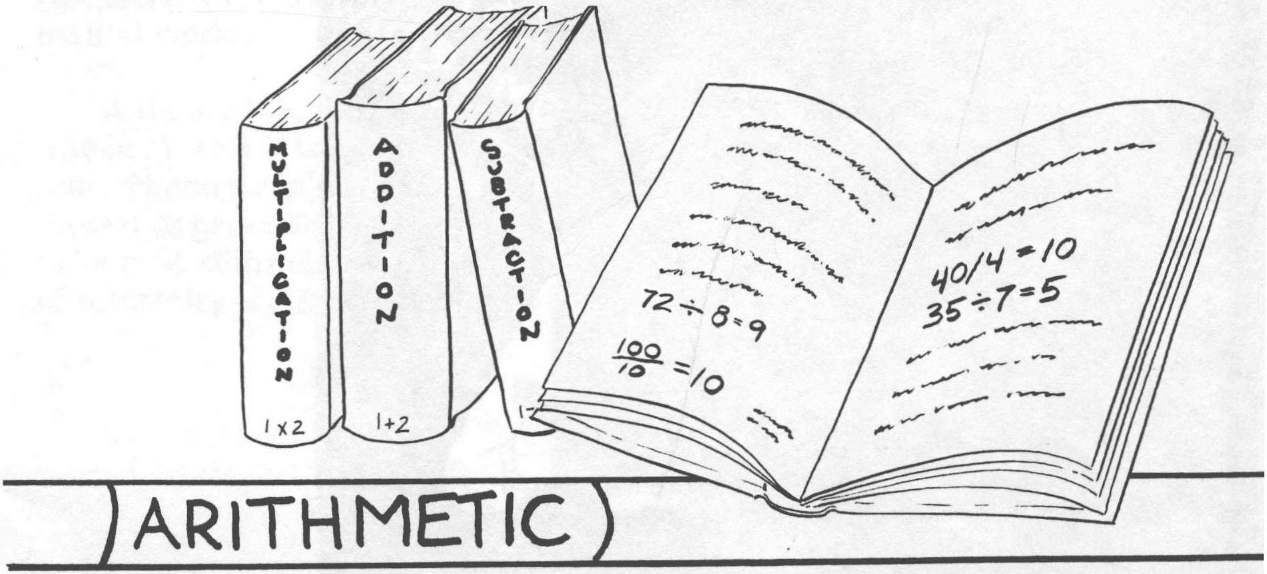
THEORY =
A principle that explains specific facts.

LAW =
A theory that checks out after repeat testing.

example.) If it checks out every time it is tested, then a theory can become a law or rule. The law of gravity is no longer a theory; no one has ever been able to make something fall anywhere but down. The idea that the universe began with a "big bang" remains a theory because it can't be demonstrated under test conditions.

What's the difference between . . .
Arithmetic and Mathematics?

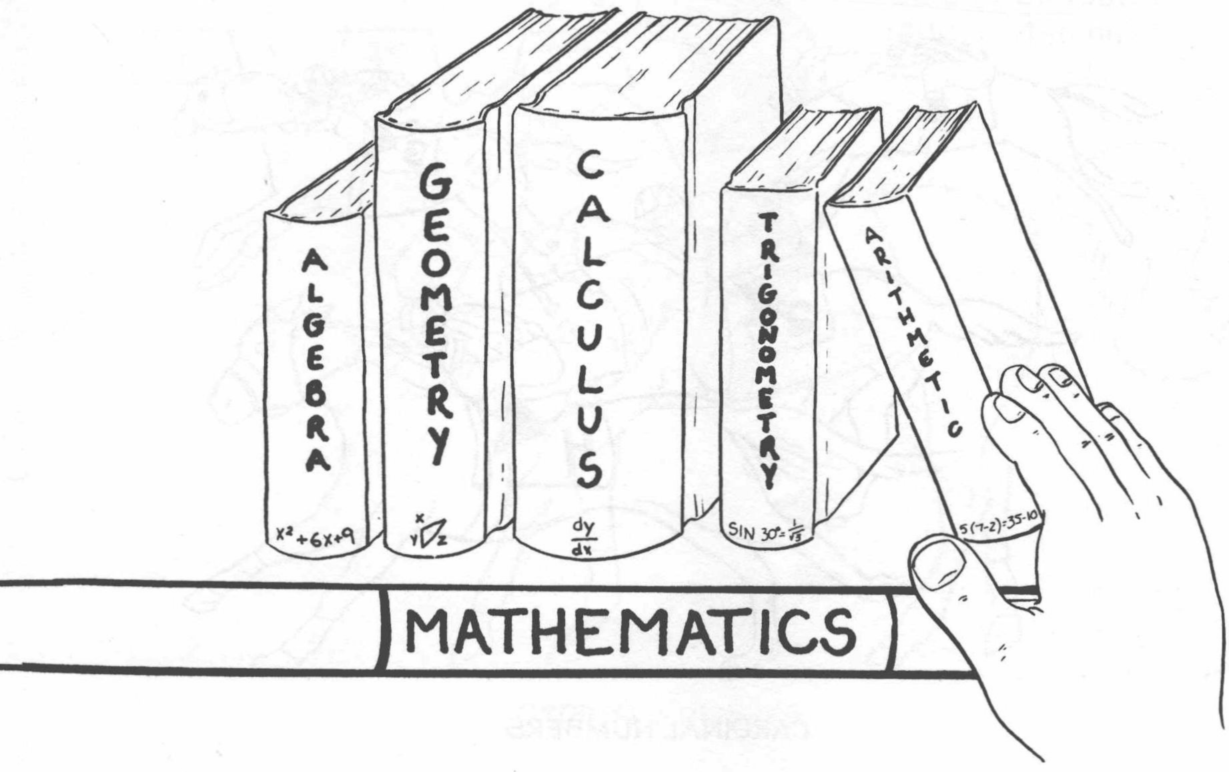
Arithmetic is the addition, subtraction, multiplication, and division of numbers. Mathematics is all that and much more.



Mathematics is the study of the measurement, properties, and relationships of quantities. It uses numbers and symbols to represent things. In addition to arithmetic, mathematics includes algebra, geometry, trigonometry, calculus, and more.

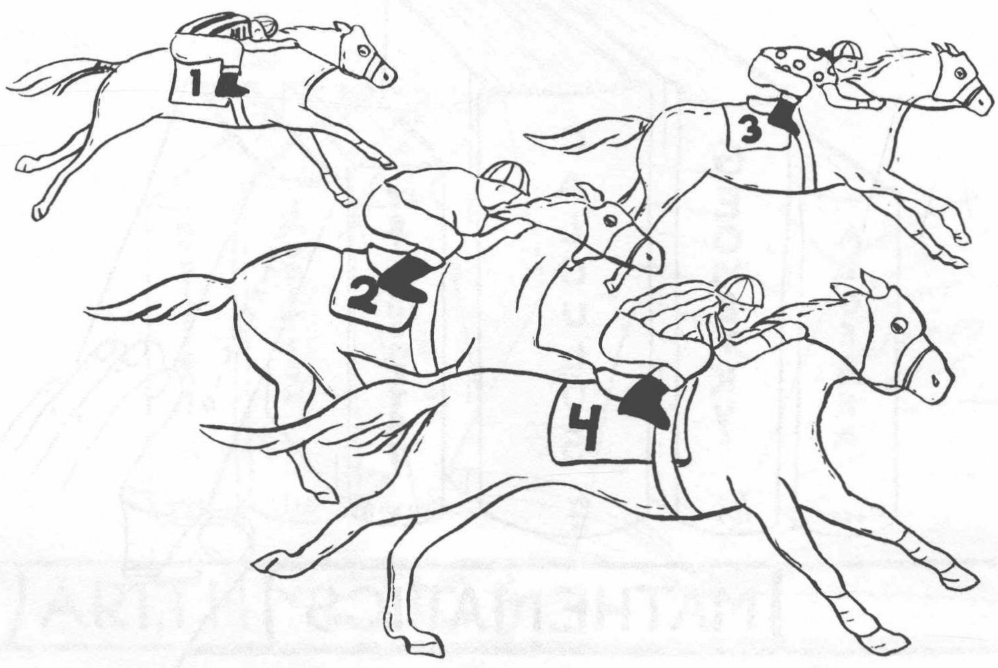
Did you know?

- In many ways, music is a form of mathematics. In music, notes, rests, and other symbols are used to represent the properties and relationships of sounds.



What's the difference between . . .
Cardinal and Ordinal Numbers?

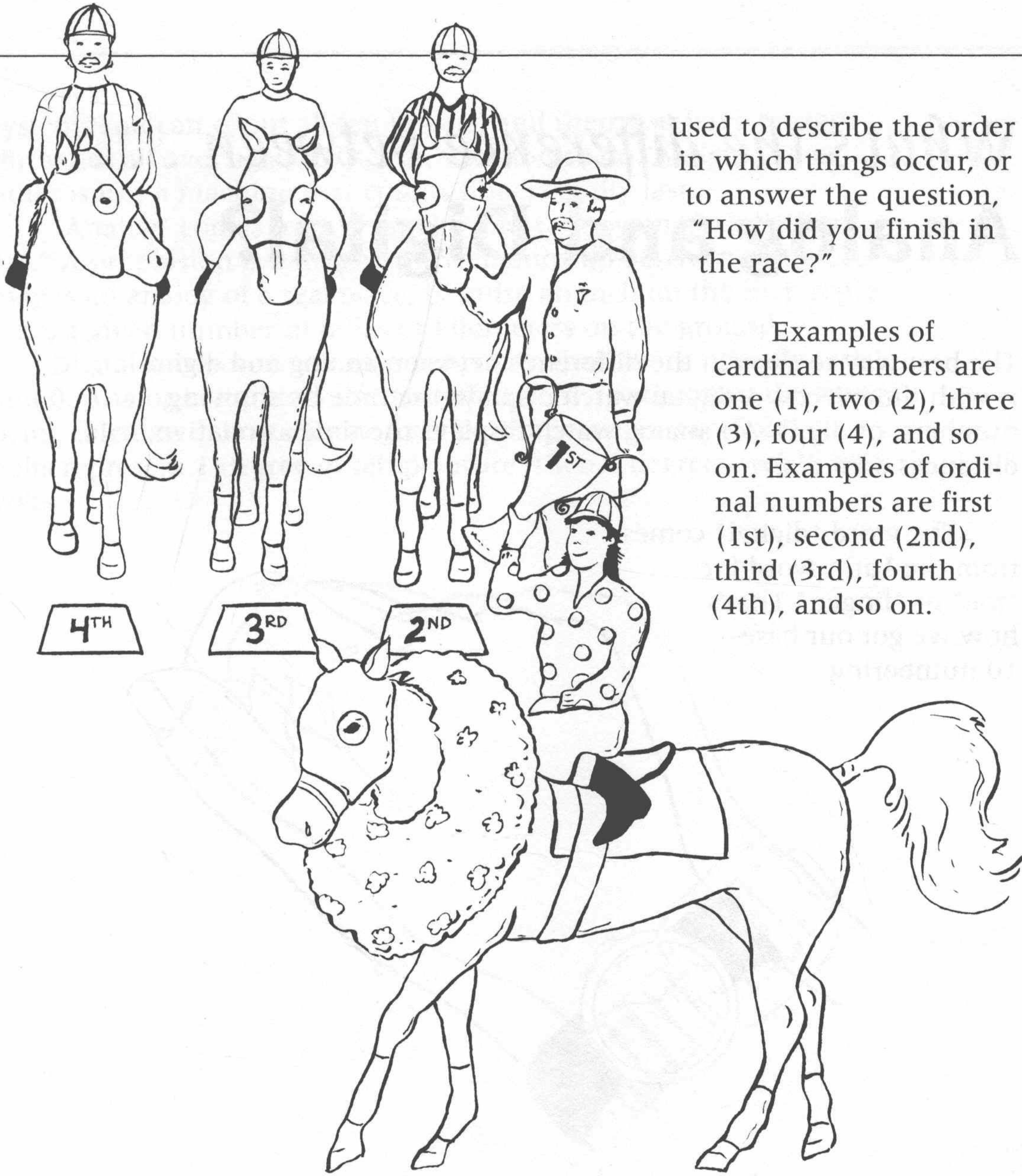
Cardinal numbers are the numbers we use to count or label things, or to answer the question, "How many?" Ordinal numbers are



CARDINAL NUMBERS

used to describe the order in which things occur, or to answer the question, "How did you finish in the race?"

Examples of cardinal numbers are one (1), two (2), three (3), four (4), and so on. Examples of ordinal numbers are first (1st), second (2nd), third (3rd), fourth (4th), and so on.

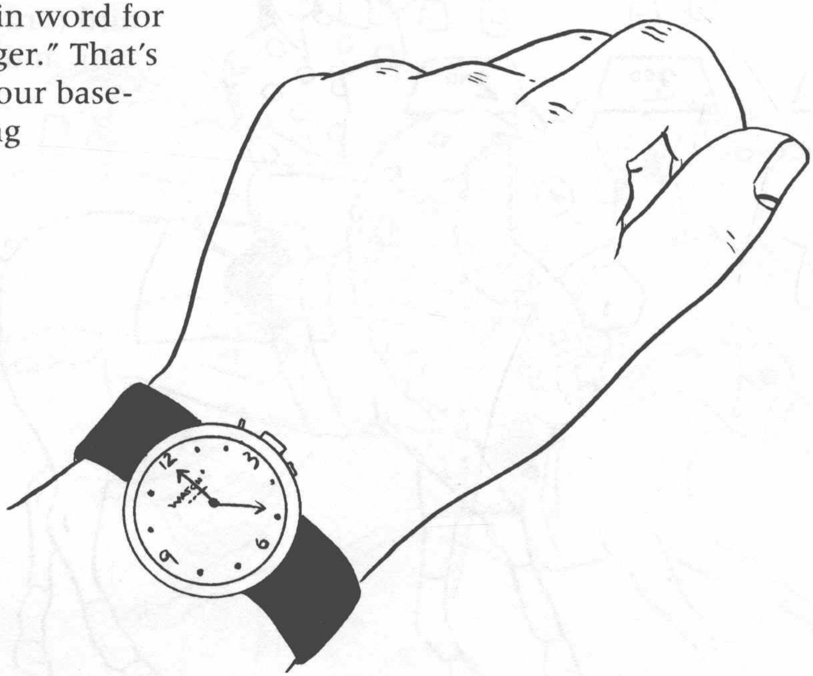


ORDINAL NUMBERS

What's the difference between . . .
Analog and Digital?

The best way to explain the difference between analog and digital is with timepieces. A digital watch displays the time by showing numbers, or digits. An analog watch displays the time as relative distances on a dial.

The word "digital" comes from the Latin word for "toe" or "finger." That's how we got our base-10 numbering

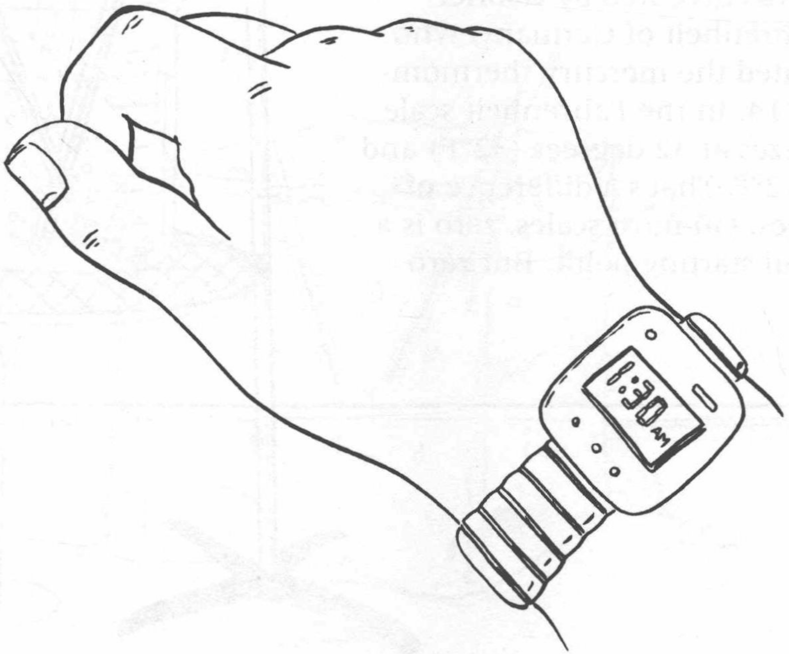


ANALOG

system. You can count all ten fingers, and then you have to start the series all over again: 10s, 20s, 30s, and so on. A digital computer is like a machine that counts fingers really fast.

"Analog" comes from a Greek word that means "proportionate." A proportion is a measurable relationship between things. A map is an analog of a real place, because an inch on the map represents a given number of miles or kilometers on the ground.

Digital computers use numbers to do their work, usually just 1 and 0. Analog computers use something else to represent the thing being calculated: **volts** for degrees of temperature, say. So, if 2 volts represent 1 degree of temperature, then 4 degrees would be 8 volts.



DIGITAL

What's the difference between . . .
Fahrenheit and Celsius?

Both Fahrenheit and Celsius are scales for measuring temperature. But they measure it against different numbering systems.

The Fahrenheit scale is the oldest of the temperature-measuring scales. It was invented by Gabriel Daniel Fahrenheit of Germany, who also invented the mercury thermometer, in 1714. In the Fahrenheit scale, water freezes at 32 degrees (32°F) and boils at 212°F. That's a difference of 180 degrees. On most scales, zero is a meaningful starting point. But zero