CONTENTS

INTRODUCTION

Scientific discovery usually requires lengthy effort. For example, Gregor Mendel spent decades working out his theory of heredity. Robert Goddard invested a lifetime developing the science of rocketry. How then can students develop scientific skills in ten-minute activities?

The answer is simple, if not obvious. Science is a way of seeking truth through observation and experiment. While big breakthroughs are rare, the process is ongoing:

- When something out of the ordinary catches a scientist's eye, that's real science.
- When a scientist wonders about something, that's real science.
- When a scientist asks a question, that, too, is real science.

Ten-Minute Real World Science offers activities that last for only a few moments, yet evoke authentic scientific work. By engaging in many mini-projects, students gradually develop the skills of science.

Practising Skills in Context

The key scientific skills are observing, describing, questioning, experimenting, and reporting. These actions come into play whether a scientist is exploring gravity, animal behaviour, sound, digestion or any other topic. In other words, astronomers, biologists, chemists, physicists, sociologists and all other scientists use the same basic approach to discover the nature of things.

Professional scientists usually specialise. But for the beginner, it makes sense to practise the skills in a variety of areas. This approach clarifies the nature of science and maximises the chance that each individual will ultimately find an area of personal interest.

How to Use the Book

The activities in Ten-Minute Real World Science appear in alphabetical order. If you want to focus on a specific topic, for example, chemistry, use the Index.

Most lessons begin with a topic for students to ponder and then write about in their science journals. Background information for class discussion is provided in the margin.

The main activity is described in a few steps. Students are asked to observe and then, in their science journals, write or draw what they observed. In most cases, you'll need no materials or only items found in the classroom or at home. Occasionally, you'll find a reference to a web site, such as one that offers magnificent lunar craters.

The **Skills** section offers activities to sharpen generic techniques, such as carrying out experiments.

Beyond Ten Minutes

An extension project accompanies each lesson. This material can be used to reinforce the given concept through independent study in school or at home.

Frequently, you'll find a list of library research projects designed to build students' general scientific knowledge and to relate their observations to a wide variety of issues – everything from cooking and bicycle riding to medicine and music.

The **Resources** section at the back of the book includes a reproducible Scientist's Guide offering tips on maintaining a science notebook, making sketches and so on. This section also contains a list of continuing projects, for example, a science book report series.

About Right Answers and Mistakes

Many science books tell students how to set up an experiment, and then immediately provide the right answer. This approach can be misleading, because in real scientific exploration answers are often elusive. Experiments may reveal nothing, or may have ambiguous results. Scientists spend lots of time in the dark. And they often reach false conclusions.

For example, when Galileo first observed the moon using a telescope, he was convinced that he saw vast seas. He also drew a large crater in the center of the lunar surface although no such crater exists. Galileo was wrong, but his method was right. By carefully reporting his observations, he set the stage for other scientists to correct his findings. The crucial thing was that he pursued new knowledge rather than relying on knowledge previously known.

This book attempts to simulate that situation so that young people can experience what it's really like to be a scientist. The aim is to encourage them to look closely at things for themselves, and to report their tentative observations, just as real scientists do.

Of course, students should be encouraged to check and question their observations. To help you guide them into self-evaluation, you'll find relevant, factual information in the margins.

ANIMAL OBSERVATION

Whales and other exotic creatures get lots of attention. But birds, ants, and other 'ordinary' animals can provide fascinating opportunities for scientific study.

DIRECTIONS:
1. Remind students that scientific observation is purposeful. The scientist isn't just looking, but is looking for something.
2. Review the Animal Observation Guidelines, next page. Then have students study a classroom pet or one of the other candidates in the margin. During the session, students should take notes and draw pictures. (For drawing tips, see the Skills section.)
3. Afterwards, share the results. Discuss problems, ('My bird flew away!'), and brainstorm solutions. This could lead to reading books about animal watching. (See Bibliography.)

EXTENSION:
Have students conduct longer-term observations out of class and share results by posting drawings from their notebooks.

A dramatic way to share observations is to imitate animal behavior, for example, walking like a dog or puckering the mouth like a fish. If students are interested in imitating bird calls, in addition to listening to bird live in nature, students might use recordings. The Internet is another source, for example, **www.birdsongs.com.**

Animals to Observe
ant
beetle
bird
cat
cockroach
dog
flea
fish
fly
frog
grasshopper
microbe
mosquito
moth
mouse
salamander
slug
spider
squirrel
worm

Animal Observation Guidelines

Scientific observation requires paying attention to details. In addition to describing things in words, you can often capture facts by drawing. For example, when studying an ant, try making a map of an ant's journey.

Think about the following points when you plan an animal observation report.

Observation information (include the following information in each observation report):
- name of observer
- type of animal observed
- name of species if known
- date of observation
- beginning and ending time of observation
- weather and temperature
- location of observation
- tools used, for example, magnifying glass

Physical description of animal
- color
- parts
- shape
- pattern of surfaces, for example, of a butterfly
- overall size (estimate if you can't measure)
- texture, for example, the shiny surface of a beetle

Locomotion
- method: crawling, flying, jumping, etc.
- speed
- path: straight, curved, zigzag, etc.

Actions observed
- building
- communicating
- digging
- drinking or eating
- fighting
- resting
- searching