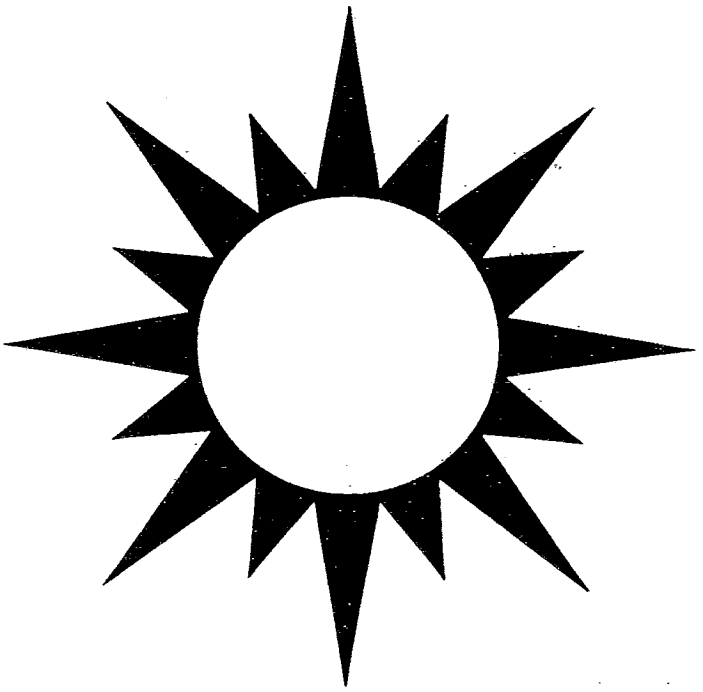

Proyecto Futuro

Science and Mathematics Activities in English and Spanish

by
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The American Association for the Advancement of Science (AAAS), founded in 1848, is the world's largest federation of scientific and engineering societies. It currently has some 134,000 individual members and nearly 300 affiliated societies and academies of science. AAAS publishes *Science*, the weekly professional journal, and *Science Books & Films*, a critical review journal for schools and libraries.

The programs and activities of the AAAS respond to a broad spectrum of scientific opportunities. In addition to its activities to strengthen school science, mathematics, and technology education, AAAS programs focus on broadening the human resource base of scientists and engineers, shaping science and technology policy, promoting the public understanding of science, expanding scientific cooperation in global issues, defending scientific freedom, and championing high professional standards.

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This book represents a collaborative effort by researchers, educators, administrators, and students to provide the teachers of English and Spanish-speaking students in grades K–8 with hands-on, drop-in science and mathematics activities. The authors would like to acknowledge some of the important members of this collaboration. Our special thanks go to:

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PREFACE

How do we increase the quality and quantity of science and mathematics education which children receive? Almost anyone who offers an answer to this question includes a discussion of the role of teachers—the need to improve their preparation, their inservice training, their access to quality curriculum and to the materials needed to deliver this instruction.

Proyecto Futuro, Project Future, was conceived as a comprehensive effort to improve science and mathematics teaching and learning for upper elementary/middle grades. In its design it incorporated a number of elements deemed key to achieving this goal, especially for the Hispanic students who were the predominant population in the Chicago schools which served as the testing, development, and training sites for this project. These critical elements included:

- ❖ a focus on activity-based science and mathematics;
- ❖ infusion of culturally relevant examples;
- ❖ alignment with local science and mathematics curriculum objectives;
- ❖ development of a cadre of teacher leaders who could train their colleagues;
- ❖ training for teachers and trainers on the curriculum to be taught;
- ❖ provision of inexpensive, easily replaceable materials for the activities; and
- ❖ development of career-oriented materials for use with students and parents.

Deliberate programming was developed for parents to recruit them as partners in supporting their children's learning of science and mathematics.

The curriculum materials provided here are building blocks for reform in science and mathematics education. They are part of an equation which includes support by community and family, professional development for teachers, a supportive administrative and policy environment, rational assessment, and a coherent vision of "what we want these future citizens to know and be able to do." The greatest value of these materials will be realized if they are viewed as examples and points of departure by teachers: one element in the toolbox for reform of science and mathematics education.

Shirley M. Malcom
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INTRODUCTION

Over the last decade, the national reform movement in K-12 science and mathematics education has repeatedly called for the increased use of hands-on, inquiry, and problem-solving approaches in the science and mathematics classroom. This lack of experimental approach has been especially critical at the elementary and middle school levels where teacher pre-service and in-service programs have not typically focused on exploring science and mathematics through the use of:

- ❖ laboratory materials and manipulatives;
- ❖ complex problem-solving; and
- ❖ relating science and mathematics to everyday life.

As a result, a wealth of materials has been developed and a profusion of in-service programs have been implemented which strive to encourage and equip teachers to implement these reforms. The overall goal has been to transform classrooms into centers of exploration, discovery, and experimentation with science and mathematics topics and equipment.

Within this national flurry of activities, however, only limited attention, at best, has been paid to the development of materials and adaptation of strategies and techniques for implementing these reforms in bilingual (English-Spanish) classrooms or other classrooms serving Spanish-speaking students. The Proyecto Futuro project is an initial effort by the AAAS to address this problem.

The overall goal of this book is twofold. First, it is designed to facilitate the transformation of science and mathematics classrooms that serve Spanish-speaking students to meet the standards set by national reform movements, particularly in the areas of physical science and mathematics. Secondly (and equally importantly) this book, and the project leading to its development, work to expand the vision further — that the contributions and cultures of various racial/ethnic groups can and should be a part of the science and mathematics classroom.

USING THIS PUBLICATION

This book is designed to supplement rather than replace current science and mathematics curricula. Activities may be used to add hands-on, inquiry, and/or problem-solving approaches in the K-8 science or mathematics classroom. For example, when teaching a unit on weather, you may want to use some or all of the activities in *Air Pressure: We're Surrounded!* to help students understand about the effects of changes in temperature, volume, and air movements on air pressure. When selecting content areas for the science units, we specifically chose physical science topics (electricity, magnetism, and air pressure) since these topics often are overlooked or avoided in the K-8 science classroom.

Considerable information is provided for the teacher for each activity. Please note that information that is provided primarily for the teacher's use is printed in English only. Information which the teacher may wish to distribute to students is provided in both English and Spanish. Each of the science and mathematics sections of the book is structured in the following way:

- Background Information. This section provides an overview of the content materials and/or relates the content to everyday life activities. In the science sections, this information is provided in both English and Spanish since teachers may want to distribute copies to their students. The background information for the mathematics sections provides general guidelines for teachers on recommended mathematics skills and teaching strategies; since it is not designed for use by students, this section is printed only in English.

- Individual Activities.

  1. Suggestions for Teachers: Each activity provides information in English for the teacher on the following topics: appropriate age groups; needed materials and their preparation; questioning strategies; safety considerations; and adaptations for students with physical disabilities.

     A special section, "Enrichment for Bilingual Students," is designed to assist teachers with activities and ideas to engage bilingual Hispanic students in the activity in one of several ways: by integrating ideas, information, and materials from Hispanic culture and/or heritage; by addressing potential language difficulties; and/or by incorporating role models. Individually, these enrichment activities will have little effect. However, when consistently incorporated into science and mathematics lessons, they can have a cumulative effect which can help Hispanic students perceive science and mathematics as "comfortable" and familiar subjects that relate to their everyday lives and in which Hispanics excel, both in the past and the present. For one example of how hands-on activities and Hispanic history and cultural aspects can be integrated into the science curriculum, see the table on page xvi. Although Hispanic contributions to science and contemporary Hispanic role models are more likely to be found in the fields of life science and medicine, it is important for children to learn about Hispanic contributions in the physical sciences, as well. For additional information, see *Hispanic Culture: Past and Future*.

  2. Activity Sheets: Following "Suggestions for Teachers," activity sheets for students are provided in both English and Spanish. For some activities, these sheets are critical. For others, you may prefer to introduce the activity verbally and not use the student activity sheets.

ADAPTING THE ACTIVITIES FOR YOUR CLASSROOM

In the course of the Proyecto Futuro program in Chicago, participating teachers at eight K-8 schools tested the written and hands-on materials provided. The following ideas were suggested to explore and enrich the project's activities:

- ❖ Set-up activity stations to provide opportunities for children to explore science and mathematics during classroom "free time."

- ❖ Incorporate local, regional, and world news to assist children's understanding that science and mathematics are part of everyday life. For example, one teacher shared a picture taken of a race in Mexico; he used this photograph with his class to extend the Proyecto Futuro activity, *Making Estimates,* by estimating the racial/ethnic composition of the crowd by sampling small sections of the photograph and counting the number of people in each group.

- ❖ Schedule times to team up with other classrooms and grades. In one school, older children presented science activities to younger children.

We hope that, as you use these materials, you will provide us with ideas and suggestions that we can incorporate into future editions.

INVOLVING PARENTS

Parents can play an important role in involving children in science and mathematics, especially in grades K-8. There are a number of ways to incorporate parent participants and support into the science and mathematics curriculum:

- ❖ Enlist parents as volunteer classroom aides for science and mathematics lessons. Engage parents in distributing materials and assisting with science/mathematics activities. One Chicago teacher shared that parents added another dimension to Proyecto Futuro activities. In short, students can learn that science and mathematics involves everyone.

- ❖ Use Proyecto Futuro activities as part of an after-school science and mathematics club. Again, involve parents as volunteer helpers.

- ❖ Conduct one or more "Science and Mathematics Parent Nights" at the school or a local church or community center. Discussions can include how to help children in science and mathematics both at school and at home and why science and mathematics are important subjects for children to master. Take-home kits can encourage parents to do science and mathematics activities at home with their children.

- ❖ Develop and distribute a monthly or bi-monthly newsletter for parents (preferably in both English and Spanish) that informs parents about upcoming events (such as achievement tests and science fairs), provides them with specific strategies for helping their child's science and mathematics studies, and gives instructions for science and mathematics activities that can be done at home.

INTEGRATING HANDS-ON ACTIVITIES AND CULTURAL CONNECTIONS INTO THE CURRICULUM: WEATHER AND WEATHER MAPS

Proyecto Futuro Activity	Related Topics	Geographic, Cultural, and Historical Connections*
Electricity Static Electricity Conductors and Insulators	lightning lightning rods grounding thunderstorms	The way that static electricity travels through the air is dependent upon the humidity of the air; different areas of the world have very different humidity levels. Many of the Mayan artifacts were destroyed by high humidity levels and frequent storms. Today, electrical engineers such as Hector Ruiz at Motorola work on developing semiconductors which make more effective memory chips for computers. Student challenge: Using daily weather maps (TV or newspaper), chart where electrical storms are most likely to occur in the U.S.
Air Pressure Can You Push Against Air? Air Pressure Power Hot and Cold Air Air in Motion **Measurement and Estimation** Weigh We Go (Use the scale to show that balloons filled with air have weight)	air mass or weight air volume storms and storm fronts tornados hurricanes wind hot air balloons altitude hydraulics sails/sailboats	Spanish explorers and navigators had extensive knowledge about air pressure and air movement in various types of storms and weather conditions and in different parts of the world. Different parts of the world have different types of weather patterns (tornados, hurricanes, tsunami, thermal inversions, monsoons, etc.). Air pressure also changes with altitude: Air pressure becomes lower as altitude increases; therefore, certain mountainous countries have lower air pressure and the people who live there must adapt to these conditions. Today, engineers such as Brian Cuevas use their understanding of air pressure to develop deep-sea rescue submarines. Student challenge: Explore why different storm types occur at different times of year (for example, thunderstorms and hurricanes) and how this affects crop planting and harvest in different areas of the U.S. and the world.
Magnetism Find the North and South Poles Exploring Magnetic Fields Which Way Is North? **Organizing and Analyzing** The Plane, The Plane Finding Your Way Making Estimates	navigation magnetism magnetic poles weather maps reading maps	Ancient Mayans and Incas mapped their buildings and crop plantings carefully to take best advantage of the movement of the sun, stars, and weather patterns. More recently, in plotting their courses, Spanish explorers and navigators used both the position of the sun and stars and magnetic compasses. Present day navigators use a variety of methods for determining their positions. NASA astronaut Franklin Chang-Diaz studies magnetism and magnetic fields in space to prepare for the design of future space stations and colonies. Student challenge: Consult with a naval or air navigator (or FAA representative) to learn about present-day methods of navigation using satellites and other technology.

* Information on contemporary Hispanic scientists and engineers is from *Stepping Into the Future: Hispanics in Science and Engineering.*